

January 18, 1960

Aviation Week

and Space Technology

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Formations**

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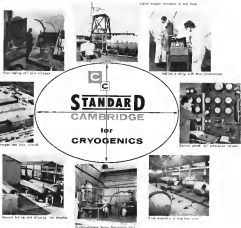
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EDITORIAL

Mr. Schmitt's Report...
Mr. Schmitt's Report

COVER

Tactical Air Command's Four Horsemen Flying in Lockheed C-130s salute the Sandhurst team right during formation. Magazine contains a simultaneous four-plane race, some breaking news and 1,600 air stories gone before your eye. Start with No. 1 airplane and timing at day and 90 day left immediately. Look for No. 2 as breaking at day and 90 day left. For any of these deceptions, see p. 10

COVER STORY
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JOHNS-MANVILLE 

EDITORIAL

Mr. Hebert's Report

The long-awaited report of the House Armed Services investigating Subcommittee headed by Rep. Edward Hebert (D-La.) has been issued today (see p. 26) and will be eagerly read in detail by defense industry management and retired military officers now employed by defense contractors. We think they will find little in the report with which to take serious issue. In general, the recommended legislation will clarify and modernize a relationship between retired military personnel and defense contractors that has been clouded by absolute regulations and stagnated by some unfair generalization.

It is inevitable that the relationship between retired military personnel and defense contractors should face some problems of propriety and some defense firm management have been far wiser than others in their handling of this problem. Mr. Hebert's investigation certainly produced no evidence that there is a generally unethical relationship in this regard or that defense contractors are let on the military "buddy system."

In fact, anybody familiar with the line drawn by defense contracting might make a case for the reverse thing. There could almost be considerable factual evidence to show that firms which had the fewest and lowest ranking retired military personnel in their payroll were getting the longest share of defense contracts, while some firms who had a glutting general staff of retired brass on their payroll were consistently on the short end of defense contract competition and had only a dwindling backlog to show for their efforts. Any intelligent and efficient business management will hire retired military personnel primarily on their technical and creative abilities for which certain areas of military experience offer excellent training.

Small Harvest

It is true that some bungling management will hope to gain an inside track to the Pentagon through a friendly retired officer of high rank, but the trend of this policy is seldom lamented. The competitive aspects of private industry usually get their cases into their proper category without any long-term requirement for special legislation. However, we think the legislation proposed by the Hebert subcommittee will serve a useful purpose in providing a uniform set of rules for such activity by retired military personnel.

Nobody can quarrel with the more realistic definition of "bidding" proposed by the subcommittee. The subcommittee's intent is made quite clear in the following portion of its report:

"This, the subcommittee intends to be a comprehensive, inclusive, 'no escape' definition of what the public be considered to be the selling game. No excuse or no corner of the kind of thing said, whether tangible or intangible, in substance or in fact, whether direct or indirect, places and weapon systems get the same treatment. Payments and proposals are weighed on the same scale. There is to be no discrimination against government officers merely because of their service as such."

The subcommittee's original fear over certain types of defense contractors' advertising and the lobbying activities of military and trade associations appears in the final report reduced to such proportions and leaving the back to other agencies for action. The subcommittee apparently fears and what other people had long known, namely that the competitive weapon system advertising has to be approved by the services involved. There has always been ample regulation to prevent abuse of this activity if the services choose to exercise it, and the contractors could hardly be held solely accountable.

Significant Facts

It is interesting to note that, while Mr. Hebert's subcommittee has been employed on a relatively minor aspect of the government/industry partnership in the defense business and the General Accounting Office has been concentrating on the inflated costs of profits of this industry, two significant facts have appeared in other areas of the government:

First, the Securities and Exchange Commission reports that during the third quarter of 1959 the percentage of profit for the defense industry as relation to net worth has dropped below the national average for all industries for the first time (see p. 101). The profit ratio on sales has been dropping sharply for the past few years, falling to 1.7% for the third quarter of 1959.

Second, Sen. Stuart Symington (D-Mo.), known better for his defense investigations but now branching out as an agricultural prober, has developed testimony before the subcommittee that shows the government has been paying grain elevator operators profits as high as 175% for storing surplus government grain. It appears to be somewhat inconceivable for a government that liberally approves 100% profit for storing its surplus grain to deprecate the return on defense contractors' sales to 1.7%.

It is necessary for Congress and the executive branch to watch closely the profit relationship of private industry and the government in its defense activities. Certainly, nobody will tolerate for long any excessive profits by industry in this area. But, on the other side of the coin, the industry cannot continue to perform adequately the technical missions the government requires if it is squeezed so hard on its side of return that it cannot accumulate sufficient funds to invest in research and development or to justify its defense work to its stockholders.

We think that, while Congress through Mr. Hebert's subcommittee and others should continue to vigorously monitor their watching function over public funds, they should also devote considerable effort to a fundamental and constructive examination of the government/industry partnership in the defense and space technology area with a view toward developing a more effective and equitable relationship than the recent policy trends will permit. Without a comprehensive constructive effort along this line, their watching efforts will still little in their avowed purpose of developing a more effective defense at a reasonable cost to the taxpayer.

—Robert Heitz

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D. J. Robert Downing, president, Space Recovery Systems, Inc., 21 Segundo, CMC, succeeding Augustus J. Sherrill, who continues in a director.

W. F. Simon, president, Aircraft Fueling Corp., Boston, N. J., a subsidiary of Cyma Aircraft Co., succeeding William F. Connelly, Jr., retired.

Philip W. Smith, president and a director, Jack H. Smith, Inc., Cleveland, succeeding Frank S. Robinson, deceased.

Robert D. Gilman, president and a director, Electro, Inc., Kingston, N. Y. Kenneth G. Fenn, vice president, succeeding Douglas Aircraft Co., Inc., Santa Monica, Calif., succeeding Fredrick W. Gilman, retired.

Lapine L. Taylor, vice president-corp. and vice president, American Airlines, Inc.

G. H. Olson, executive vice president, Air Research Mfg. Co., a division of Air Research Co., Inc., New York, N. Y.

Paul H. Egan, vice president-sales, Conquest Engineering & Research Co., El Monte, Calif.

Lincoln W. Chang, vice president-production, Wyle Manufacturing Corp., El Segundo, Calif.

W. R. Beck, secretary and corporate counsel, United Research Corp., Mobile Park, Calif., a subsidiary of United Aircraft Corp.

Dr. Thomas W. Clark, chief of staff, Army Ordnance Missile Command, Huntsville, Ala.

Col. Melvin N. Abramovich, chief Washington, D. C., Regional Office of the Air Research and Development Command, USAF.

Honors and Elections

Dr. George Edwards, executive director of Victor-Sundberg (Aircraft), Ltd., has been named 1969 recipient of the Daniel Guggenheim Medal for a lifetime devoted to the design of military and commercial aircraft engineering in the aircraft industry who made notable personal service at the last service-oriented paper-for-peace award.

Alfred H. Canada has been appointed to the position of the Institute for Defense Analysis, Washington, D. C. Mr. Canada is on a year-long leave of absence as manager of Advanced Engineering Division in General Electric's Advanced Electronics Division.

Donald W. Douglas, Jr., president of Douglas Aircraft Co., has been elected honorary chairman for 1969 of the Export Association of Aerospace Industries. **Alan A. T. Boudin**, vice president of North American Aviation, was elected chairman, and **Robert W. Douglas** of United Aircraft Corp. was chairman.

(Continued on page 148)

INDUSTRY OBSERVER

► First flight test of the Army-Martin Preparing solid-propellant tactical missile (100710 g) made in expected before May 1 from the recently completed Preparing missile at Air Force Missile Test Center's Cape Canaveral, Fla. Preparing is assembled and put through an extensive checkout at Martin's Orlando, Fla., facility, but all static tests of the two tactical engines are conducted at the Army Ballistic Missile Agency in Huntsville, Ala. Stages can be released and static fired more than once.

► Secret solid-propellant research rocket, which National Aeronautics and Space Administration had expected to fly before the end of last year (AW Oct. 19, p. 21), now is not expected to fly until tested before spring. Primary reason for the delay is that NASA underestimates the length of time required for the in-house part of secret development work being done at its Langley Research Center. As late as early last October, NASA had hoped to make the first launch from Wallops Island, Va., before Dec. 31.

► Air Force-Corvus Atlas 43D ICBM recently fired over its full 6,300 mi range from Cape Canaveral had almost 18 sec. of unused fuel remaining at the termination of its flight. Reasoning, fuel represented an additional equivalent range of approximately 1,000 mi.

► Mite Corp., of Boston, will serve as host to a winter study group being formed by the Air Research and Development Command to study overall Air Force requirements for electronic data processing systems for the 1968-73 period and the possibility of developing portions of support systems that are now under development (AW Dec. 28, p. 15).

► Air Force weapons board and Air Command will be given a complete report on progress and status of the Minuteman solid-propellant ICBM weapons system development within the next future. Presentation will be made by Air Force's ballistic missile complex at Goddard, Calif.

► French are making a major bid to persuade the Australian government to relocate the purchase of the Mirage 19 supersonic fighter than Lockheed's F-104, which the Royal Australian Air Force apparently favors. France, with an almost balance of trade with Australia and in search of orders, is offering low prices and a number of modifications, including fitting the RAAF Mirage with an Australian-built engine. However, political considerations seem probably will give a substantial edge to the F-304 in any actual purchase. Australia has reported strong "two bodies" bids from the French, as well as the fact on grounds that, in the event of war in the Pacific, it would be dependent upon logistic support from—and conducting the major portion of its fighting in cooperation with—the U. S.

► Lockheed Martin and Space Division is completing installation of a two-stage high velocity wind tunnel at its Palo Alto scientific research facility capable of sustained velocities in excess of Mach 30 and up to 4,000 G. Generator with the capacity of producing two million watts can, naturally or five million watts for two minutes can sustain velocities and temperature conditions for hours.

► Launch Complex 30 at the Air Force Missile Test Center, designed Dec. 12 by the explosion of an Air Force-Martin Titan ICBM test vehicle (AW Dec. 21, p. 19, Jan. 11, p. 68), was put back into service on Jan. 11. Repair operations were expected to require approximately two months. Titan C-4 was erected when the pad was ready for use and probably will be fired after the flight of the B-7A, expected sometime this week.

► Soviet Union and Czechoslovakia have signed a new technical cooperation agreement lasting 749 branches of a joint cooperation commission, through which exchange of scientific and technical information is to be maintained during 1965-70. The commission is to be organized during the year, 1967 and 1968. Czechoslovakia also is scheduled to continue coordinated work in a number of major scientific problems.

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Washington Roundup

B-70 Rescue Operations

As Foco and congressional advocates of meeting at least a portion of USAF's operational phase for the North American Aviation Mach 5 B-70 bomber from Administration support such are willing to compromise for a small segment of fully-equipped, available as opposed to original USAF plans for 62 planes, and the Budget Bureau's note that only two prototypes without major alterations be built (AW Dec 7, p. 28).

Capital Hill debate on the need for the B-70 probably will be resolved only during initial operations of the Force Chief of Staff Gen. Thomas D. White as support of USAF's Fiscal 1961 budget. Added at a National Press Club luncheon last week, if the December outlook represented in the Force or a Budget Bureau decision, Gen. White replied "I can never tell, though. It won't be an Air Force decision." He said that "I wouldn't be here" if he had been unable to accept the decision, but later added:

"As a properly constituted human, you can be certain I will be both honestly and sincerely in no conflict."

President Eisenhower was asked to comment on Gen. White's remarks at his press conference last week.

■ **L. Edgar Price, Washington Star**—Foco said that Air Chief Gen. White said at the Press Club luncheon he believes that the virtual cancellation of the B-70 program was a budgetary decision, not a Force decision, and he indicated that he might take it up on Capitol Hill.

■ **The President**—"I will see this. It is certainly not a budgetary decision because there is money in the budget and, as I pointed out, there was a budget that I hoped we could get off some of our debt."

"It was no question as to the measure for particular reasons at a particular time. The B-70, as an operational weapon, is going to take a long time to produce, and we certainly ought to be at a pretty strong position in many other ways before that year elaps."

World Congress Canceled

As Force Ann is extending plans to hold its second World Congress of Flight meeting this year in Washington, a source that was to have been highlighted by a Gen. van Hise report the world flight with plans to launch on this is being postponed. "World Congress" was supposed to have been staged by leading U. S. military and civilian officials. Main reason for the cancellation, which puts a crimp into AF's plans to hold the congress on aircraft with the Force's plan, is that it is being postponed. It is a source that was to have been highlighted by a Gen. van Hise report the world flight with plans to launch on this is being postponed. It is a source that was to have been highlighted by a Gen. van Hise report the world flight with plans to launch on this is being postponed.

Army Diverted

Army apparently has been diverted from its mission to the Defense Department to ensure management responsibility over all helicopter production and development for the three military services. Army questioned this, as the major user of helicopters, it was the one service with serious interest in its development. In this field, war severely cramped when an Air Force Ka-50 1944-B flight by two USAF pilots recently established a world's altitude record for its class of 30,100 ft, breaking a previous mark held by the Soviet Mi-2 (AW Mar 12, p. 47).

ing a previous mark held by the Soviet Mi-2 (AW Mar 12, p. 47).

Atlas Scorecard

On the 14 Air Force-Corps Atlas ICBMs which President Eisenhower said expected within an average of two miles of their target at ranges over 1,000 mi. (AW Jan 11, p. 28), seven hit well within a two mile radius of the target. One Atlas hit exactly two miles from its target, and the remaining six strikes appeared more than two miles from the target. All of the 14 Atlas launched by the President in his State of the Union message were equipped with radio command guidance, a system that is most accurate than the inertial guidance system that will be used in later versions.

Another Blast at STL Status

Congressional sources expect General Accounting Office to call for an end to the private enterprise status of Space Technology Laboratories, technical manager of Air Force ballistic missile program, in a comprehensive report on USAF missile management which will be submitted to Congress shortly (AW Jan. 4, p. 17). The report will recommend the reconsideration of the House government military operations subcommittee last fall. The subcommittee, headed by Rep. Carl Albert (D-Calif.), declared that if STL is to continue as technical manager of "must be converted into a nonprofit institution" (AW Sept. 18, p. 146). USAF has replied to the House group that a special committee headed by Gen. G. H. Buehler, professor of aeronautics at California Institute of Technology, is evaluating the recommendations.

Republican Speech Circuit

Republican National Committee has attracted T. Keith Clements, National Aeronautics and Space administrator, and E. R. Quisenberry, Federal Aviation Agency administrator, as guests for its next fund-raising "Dinner With the" scheduled for Jan. 27. Clements will speak in Jackson, Mich., and Quisenberry in Saginaw, Mich. Other "the" speakers will include Defense Secretary Thomas S. Gates, Jr., in Portland, Ore.; Army Secretary Wilbur M. Bricker in Charlotte, N. C.; Navy Secretary William B. Franke in Richmond, Va.; Assistant Defense Secretary Marvin S. Smith in Atlanta, Ga.; and Assistant Army Secretary Devitt Smith in San Antonio, Tex.

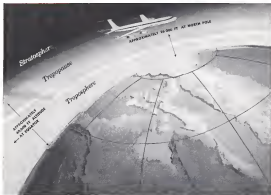
Curtis's Return

Robert Curtis, who stepped two years ago as the President's special assistant for defense affairs, after for "which personal reason" is returning to Washington as executive director of the Organization of American States Inter-American Development Bank, now in its formative stages. Curtis, charged by his critics with often withholding vital information on Soviet progress from the President during his White House tenure, was one of three top U. S. officials appointed to the bank by the President last week, and he will serve a five-year term. Other appointed were Timmerman Robert B. Anderson, governor, and Thos. Curtis, of State Department, director of the bank. Curtis, after leaving Washington in June, 1955, returned to Boston to resume his chairmanship of the Old Colony Trust Co. —Washington staff



POLAR FLIGHTS

Low Arctic Stratosphere on Polar Flights ... Provides Warmer High Altitude Temperatures than in Tropics!



TEMPERATURE is a lower troposphere and resulting lower stratosphere, temperatures above approximately 20,000 feet in the polar regions are usually colder than they are at a comparable height in tropical regions ... and they usually vary much from between minus 40 to minus 10 degrees Centigrade at an altitude. For example, following the polar route, this means that they have virtually a stable atmosphere for the larger part of their journey.

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Only as the line ... Mobiljet 158—an ideal long-range fuel—designed just for high performance airline operations. Mobiljet 146—a performance-proven aviation fuel with —40 F freeze point.



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data throughout the approach.

The Board and it doubted the cockpit judgment that the crash happened shortly after a 500 ft. altitude reading, and it theorized that Hirschfeld tried to maneuver and cut out autopilot and altitude below 500 ft. because he probably was anticipating landing cut beneath the extent and, having seen some ground lights, was focusing on visual identification of the airport instead of maintaining the flight instruments.

Criticizing the experience of the Electric crew members and American's training program, CAB noted that Capt. DeWitt had about 45 hr in the Electric at the time of the accident. His general training received 54.5 hr of which 55.1 hr was devoted to aircraft systems and 16 hr to operations and procedures.

The pilot's last type rating check for the Electric was made after eight hours of flight training, but DeWitt failed a portion of the check and referred to successfully pass his type rating and instrument check after 12 hr of training on the turboprop aircraft.

CAB noted that American's operations specifications require specified rolling and visibility landing minimums to be increased by 100 ft. in rolling and one-half mile in visibility when a pilot on scheduled service hasn't flown 100 hr as captain in the aircraft involved. Regional superintendent of flying can waive this requirement and certify the pilot as qualified to operate at specified minimums.

If these restrictions are to serve as a prompt after them to pass the experience of a successful flight operation policy, the Board questions the wisdom of the company in employing Capt. DeWitt when he had but 12.52 hr of flying the Electric in scheduled operations. The Board said "This concern was born before the accident." CAB has asked FAA to determine whether the waiver provision should be deleted from operations specifications.

CAB particularly questioned the airline for lacking to include the proper altitudes and rate of descent guidelines in the general training program and for the lack of a comprehensive aircraft simulator program for the Electric.

Expanding criticism over the absence of an simulator program, the Board said introduction of the Electric had increased the concern since "almost all

aircraft operations aspects of axes and substantially different equipment, systems, and procedures, could have been avoided through more comprehensive training in an aircraft simulator. CAB said that the airline was asked to meet compliance of such simulator training program by pilots before approaching their assignment as pilot in command. American Airlines and lost work that it had ordered in Electric simulator more than two years ago and expected to take delivery of it about a year ago but that time, the airline's performance has failed to meet either the airline's or FAA's performance requirements. The carrier says it now has an definite date on which it expects to take delivery of the simulator.

The Board also asked FAA to require the installation of flight simulators on all turbine-powered aircraft to provide a continuous flight reading of time, speed, altitude, vertical acceleration and heading as well as to disseminate accident cases with greater precision.

New York Airways Orders 10 V-107s

New York—The World 100 fastest powered helicopters have been ordered by New York Airways, with the first five expected to go into service in the spring of 1967.

The helicopter service personnel had taken action on five of the turbine-powered aircraft (AW No. 8, p. 47) for early 1965 delivery. This covered the first five production orders of the aircraft.

Remaining five the order will be delivered by the end of 1965. The five 107s scheduled for service next year will provide capacity for 50, 000 passengers a year, an increase of 400% over the present fleet of V-107s, according to New York Airways President Robert L. Cummings. The full fleet of 107s will therefore provide for a million annual passengers.

Cummings and the 15 passenger helicopters would cruise at speeds above 150 mph, carrying flight times from Newark Airport to La Guardia Airport from 14 to 19 min., as one example. Reduced angle engine, subsonic design requirements with the turbine helicopters probably will cut another minute from the schedule, Cummings said.

Helicopter schedules are generally over 50 min., Cummings said, and speed and reliability of the new fleet will allow schedules under 35 min. By 1967, the airline will be doing "high altitude" operations from the mainland "in a much improved operation," according to the New York Airways official.

Availability of the Farm, Robinson VTOL, in late 1966, Cummings said,

will permit further expansion of service "as a second business hour." New York Airways has signed a letter of intent to buy the Robinson.

FAA Requires Radar On Airline Transports

Washington—The Federal Aviation Agency last week adapted a new rule requiring the replacement of airborne weather radar on a majority of commercial airlines as a means of preventing aircraft accidents caused by severe air turbulence.

Installation is required by July 1 on all Lockheed jet turboprop aircraft, by Jan. 1, 1967, for the Douglas DC-6 and DC-7 and the Lockheed 345 and 346 series, and by Jan. 1, 1967, for all transport aircraft, including the Boeing 377, Cessna 240, 240 and 440, Lockheed 049 and 749, Martin 301 and 401, and the Douglas DC-4.

Excluded from the rule, but being actively considered by the FAA for later inclusion, are the DC-3, Lockheed L-18 and the Cessna C-46, all of which are considered to be non-turboprop aircraft not covered in the original rule.

The rule also includes helicopters and aircraft used for cargo, testing, training or ferry flights, as well as aircraft operated solely in Alaska and Alaska where, under certain conditions, detected by airborne radar can be used.

FAA said it estimated the DC-3, L-18 and C-46 because they do not fit the "transport category" meaning of the rule.

As a further notice to airlines, FAA noted that after Mar. 31, all transport category aircraft equipped with airborne weather radar must not be dispatched under instrument flight rules or night instrument flight rules when hazardous weather is expected to exist unless the radar units are in working order.

Should the radar fail while en route, the aircraft must be operated in accordance with instructions and procedures specified in company operations manuals approved by the FAA for such an event.

Landing Gear Forces American 707 Abort

New York—An American Airlines Boeing 707-120 jet transport returned to Idlewild last week two hours after taking off when its landing gear failed to retract.

The scheduled flight took off about 4:45 p.m. and its landing gear failed to retract the gear. Low fuel pressure in the gear landing cylinder had activated an automatic cutoff which stopped the retraction cycle.

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IN AIRLINE SERVICE**

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ROLLS-ROYCE GAS TURBINES



Monroney Introduces Cargo Aircraft Bill

Washington—Sen. A. S. Mike Monroney (D-Okla.), chairman of the Senate Commerce-Airline Subcommittee, last week introduced legislation aimed at expanding the national cargo airlift capacity by authorizing the Civil Aeronautics Board to guarantee loans for the purchase of aircraft. Monroney first introduced his plan for such legislation last fall (AW Oct. 26, p. 24).

Edward H. Quensell, Federal Aviation Agency administrator, indicated that the Administration will support the measure.

Under Monroney's proposal, a single airline would be eligible to obtain a guarantee guaranteeing an loan of up to \$7½ million for the purchase of cargo planes and up to \$10 million for the purchase of "intermodal components of a cargo airlift system." The guaranteed loan would not exceed 75% of the present price of the aircraft and would have to be repaid within 10 years.

Both Monroney, in a Senate speech, and Quensell in a speech to Senate subcommittee representatives here, urged a rapidly expanded airlift capability last week.

Monroney declared that "the indispensable element in preparedness for future war involves a mobility and in the decade of the sixties, military mobility means military airlift."

Quensell said that "as government, we are trying to create the climate to facilitate the development of a dynamic military or even industry" and urged the industry to "face up" to its responsibilities. He reported that FAA also is studying government guarantees of loans for cargo aircraft purchases and aid.

"These loans, in combination with the airlift of substantial quantities of routine government or cargo traffic by the civil air service, would greatly stimulate the air cargo industry and provide an incentive to modernize the present fleet and greatly expand its capability."

The Monroney bill directs government departments and agencies to make "an immediate and active transfer of increasing quantities of routine government sponsored air cargo traffic to the established air carrier."

Meanwhile, there also were these two dispiriting:

• Comprehensive report by the Department of Defense making recommendations on the operations and re-equipment of the strategic fleet of Air Force's Military Air Transport Service has been submitted to the White House last week and is expected to reach Congress early this season. Monroney urged MATS to transfer all routing inquiries to commercial carriers. Quensell noted that "to the extent that de-

velopment and production expenses can be spread over the largest number of units, in both military and civil procurement, unit costs will be proportionately reduced. The dollar savings, to both the military and civil sectors, would be substantial."

• Federal Aviation Agency, Air Force and commercial air carriers are approaching agreement on the acceptable design characteristics of a low-cost cargo aircraft suitable for military and commercial operations. Reporting on an FAA poll of the airline industry, Quensell said "The airlines are starting to come in and this response is greatly encouraging. The air carriers are enthusiastically interested in developing the air cargo market and are looking forward to the availability of efficient, economical cargo aircraft to develop potential as pointed."

Loon Foregoes

A guarantee for a loan guarantee under the Monroney measure is a report of the Senate the aircraft is to be purchased by the Federal Aviation Agency administrator and the Secretary of Defense. Another requirement is that the aircraft be available to Defense Department in an emergency, and during the period of the guaranteed loan be used "primarily" for transport of cargo and mail.

Quensell declared that it is "discouraging" that less than 3% of the 600 independent aircraft inside the U.S. air-

lines will have in their inventory by mid-1967 will be airlifters.

Noting that the Defense Department has used "hundreds of millions of dollars" by searching from surface to air transport, the legislation support Quensell predicted that businessmen will follow the example.

He said:

"As the federal is being efficient, economical cargo aircraft is a general, rather than a previous, means of transportation, business firms will be able to reduce inventories, reduce or eliminate warehouses and depots, cut labor requirements, handling, and insurance charges and achieve lower capital investment costs. Several forward thinking companies are doing this now. But the gap between future air and surface transportation unit costs must be drastically narrowed for this type of total distribution cost thinking to pay off."

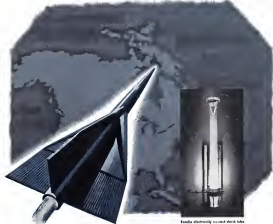
Quensell and efficient airlines, designed from the drawing board to accommodate cargo and interconnecting airline systems with economical performance characteristics, could have potential operating costs and other rates.

He added that a substantial expansion of air cargo "is of compelling importance in furthering our foreign efforts." In the event of disarmament, he said, "the development of a national air cargo industry would be a great boon by putting shipping facilities and equipment released from unnecessary production."



Eastern Schedules DC-8 Service Jan. 24

Delta DC-8, airport transport will begin commercial service Jan. 24 on Eastern Air Lines New York-Miami route (AW Jan. 13, p. 48). Flights there shows extra service looking through first-class compartment, with two-class seating.



PLASMA PRODUCTION

...for magnetohydrodynamic investigations

Hypersonic flight can generate ionized shock layers with free electron densities as great as 10^{16} particles per cc. Temperature near the stagnation point can be as high as 7000°C. This is the self-generated environment of a missile or aircraft traveling at Mach 30 in the upper atmosphere.

To create these conditions in the laboratory for magnetohydrodynamic and electromagnetic propulsion experiments requires a hypersonic wind tunnel. The Bendix electrically actuated shock tube is such a research tool. Discharge of a supersonic bank into a conical region at one end of the tube initially creates a shock wave which is driven down the length of the tunnel past the test body. Flow velocities up to 75,000 ft/sec and temperatures of 20,000°C can be generated.

By passing electric and magnetic fields through the plasma in the shock tube, Bendix engineers can measure the attenuation of radio transmission through the ionized layer surrounding hypersonic vehicles. They can also investigate the acceleration of conducting gases for space propulsion, and the feasibility of direct conversion of thermal energy to electrical energy.

Plasma production is one of the projects being carried out at Bendix Systems Division to solve the technical problems which are the keys to the systems of the future. Other investigations include satellite communications systems, navigation systems, advanced infrared reconnaissance, and the EAGLE Air-to-Air Missile System. Inquiries are invited from better engineers also looking to the future.

Bendix Systems Division

... ..

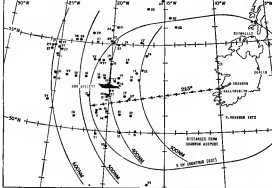


Airline Traffic—November, 1959

	Revenue Passengers	Revenue Passenger Miles (RPM)	Load Factor (%)	U & Mail	Express	Freight	Total Revenue- Tax-Miles	% Revenue in excess of 100 miles
DOMESTIC TRAFFIC								
American	667,376	461,793	68.1	1,814,588	697,691	8,199,311	10,743,789	56.3
Boeing	179,507	74,804	41.7	100,218	100,218	4,913,999	5,114,435	56.7
Continental	57,845	41,303	69.8	134,131	261,830	343,000	10,734,200	20.3
Delta	524,419	345,290	65.9	1,579,149	100,144	1,766,000	10,734,200	56.4
Eastern	490,320	339,200	68.9	999,257	482,444	1,490,800	10,661,168	56.2
Northwest	146,324	87,071	59.5	312,569	93,497	271,334	5,343,397	56.3
Southwest	74,307	54,104	72.8	114,583	42,537	136,650	5,343,397	56.4
TWA	142,497	99,104	69.6	299,008	207,330	115,000	10,500,417	56.3
United	227,107	161,743	71.2	475,759	758,550	933,000	10,500,417	56.3
Western	168,443	73,143	43.4	307,253	91,875	374,193	8,646,190	56.3
INTERNATIONAL								
American	8,720	8,833	99.4	9,267	318	171,611	1,891,000	56.7
Boeing	4,737	4,737	100.0	4,737	1	90,889	956,889	56.7
Continental	26,860	26,860	100.0	1,709	8,179	100,480	738,180	56.7
Delta	3,475	3,475	100.0	4,260	26,077	912,289	1,040,626	56.8
Eastern	39,374	41,707	105.9	4,260	166,465	5,784,359	6,055,084	56.9
Northwest	8,868	1,704	19.1	8,868	4,503	107,167	1,199,538	56.9
Southwest	3,316	3,316	100.0	3,316	46,739	210,077	216,132	56.9
TWA	13,440	13,440	100.0	1,643,172	1,364	5,769,775	7,134,001	57.0
United	4,306	4,306	100.0	8,500	121,267	1,011,694	1,141,161	57.0
Western	10,078	10,078	100.0	1,899,350	3,444,790	18,601,497	22,945,637	57.1
American	10,078	10,078	100.0	890,194	4,944,790	18,601,497	22,945,637	57.1
Boeing	10,078	10,078	100.0	890,194	4,944,790	18,601,497	22,945,637	57.1
Continental	10,078	10,078	100.0	890,194	4,944,790	18,601,497	22,945,637	57.1
Delta	10,078	10,078	100.0	890,194	4,944,790	18,601,497	22,945,637	57.1
Eastern	10,078	10,078	100.0	890,194	4,944,790	18,601,497	22,945,637	57.1
Northwest	10,078	10,078	100.0	890,194	4,944,790	18,601,497	22,945,637	57.1
Southwest	10,078	10,078	100.0	890,194	4,944,790	18,601,497	22,945,637	57.1
TWA	10,078	10,078	100.0	890,194	4,944,790	18,601,497	22,945,637	57.1
United	10,078	10,078	100.0	890,194	4,944,790	18,601,497	22,945,637	57.1
Western	10,078	10,078	100.0	890,194	4,944,790	18,601,497	22,945,637	57.1
LOCAL SERVICE								
American	48,691	8,661	17.6	11,663	33,115	37,463	171,399	58.6
Boeing	19,622	4,799	24.5	7,427	9,159	6,911	62,443	58.6
Continental	12,540	3,468	27.6	3,468	7,461	1,914	22,343	58.6
Delta	26,529	4,402	16.6	12,000	10,693	29,661	73,766	58.6
Eastern	19,621	3,468	17.7	3,468	7,461	1,914	22,343	58.6
Northwest	8,868	1,704	19.1	8,868	4,503	107,167	1,199,538	56.9
Southwest	3,316	3,316	100.0	3,316	46,739	210,077	216,132	56.9
TWA	13,440	13,440	100.0	1,643,172	1,364	5,769,775	7,134,001	57.0
United	4,306	4,306	100.0	8,500	121,267	1,011,694	1,141,161	57.0
Western	10,078	10,078	100.0	1,899,350	3,444,790	18,601,497	22,945,637	57.1
HAWAIIAN								
Alaska	39,126	6,658	16.8	9,391	2,416	201,692	247,509	27.6
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† *StatView*, Abacus Concepts, Berkeley, CA.

disseminated the AUSA/DOJ WEEK from within contacts in the Civil Aeronautics Board



TROPOSPHERIC SCATTER station in Ireland, used by Pan American World Airways, provides reliable VHF ground-to-air communications at distances of 500-600 mi., more than double the usual range. Use of VHF troposcatter station, now under construction for complete coverage of North Atlantic air routes, eliminates long-range and signal deterioration that plague presently used high frequency radio. Each dot on map above indicates maximum distance at which signal was received on a specific night. Number indicates signal altitude.

IATA Studies Scatter Communications

By Philip J. Klein

Washington—Use of VHF troposcatter for ground-to-air communications over the North Atlantic to avoid the outages and confusion that plague present-day high frequency (HF) radio is being studied by the International Air Transport Association, and may soon be proposed to the International Civil Aviation Organization.

Forecasting trends in Pan American World Airways has shown that troposcatter can provide reliable two-way ground-to-air communications at distances of 500 to 600 mi., and even under adverse conditions, is compared with range of only 200 mi. obtainable with conventional VHF radio.

Particularly important to the airlines, existing reliable VHF equipment can be used with only a slight, low-cost modification in the present. On the ground, a more powerful transmitter, more sensitive receiver and a repeater antenna array are required but these are not especially expensive.

Pan American is now evaluating

tropo scatter over portions of the North Atlantic using a station located at Ballyvaughan, Ireland, 50 mi. from Shannon and another at Funchal, Azores, on the Azores Islands. The Ballyvaughan station, owned by Telecommunications, Ltd., of Dublin, is providing consistent two-way radio contact at distances of 450-500 mi., occasionally to 600 mi.

Range Doubled

Another station at San Francisco operated by Aeromarine Radio, Inc., is providing VHF tropo scatter service on the Pacific route. Occasionally, two-way troposcatter communication "radio distance" (AW No. 3, p. 35) which boost the range out to as much as 1,000 mi., Pan American reports. Do at least five flights, Pan American reports have maintained continuous radio contact on VHF from the mainland to Hawaii.

Pan American is planning additional tropo scatter communication installations at Bangkok, Rangoon and in Beirut, Lebanon.

A recent IATA technical panel has

proposed a plan for the North Atlantic which it is expected will provide complete VHF coverage of all year-round (northern) air routes and most of the northern (northern) air routes. With the addition of several shipboard VHF stations, the radio in the vicinity of air routes could be filled in.

The full IATA plan suggests VHF tropo scatter installations in Bermuda, New York, Montreal, Gander, Goose Bay, Funchal, Rio, Santa Cruz, (Spain), Frankfurt, and Paris. Christchurch (Germany), Ireland, Frankfurt, Stuttgart, Lisbon and Santa Maria, in addition to the new one established near Shannon. However, implementation can be on a partial or piecemeal basis.

The success of VHF tropo scatter for ground-to-air communications is expected to reduce the need of over-air contact in having single sideband HF equipment, particularly for North Atlantic operations. As one Pan American communications captain put it:

"We feel we can buy more equipment in communications per dollar with VHF tropo scatter than with

single sideband, and tropo scatter is not vulnerable to several disturbances."

In the Pacific, where geography is not as suitable for a series of troposcatter ground stations and where, as well-developed as not a problem, the new technology is less a threat to single sideband, otherwise below.

Tropo scatter was originally developed for military point-to-point communications on the DEW Line. Several years ago, Pan American began to investigate its possible use for ground-to-air communications. Four operational test units on experimental installations at Shannon point to successful that another was tried at San Francisco followed by others at Hong Kong, Funchal and subsequent plans for the two in Asia and the Middle East.

Pan American found that it obtained satisfactory tropo scatter communications in all altitudes used by the airlines, up to almost 45,000 ft. Signal strength proved less dependent upon signal altitude than for several high-altitude tropo scatter systems.

Troposcatter increases during the more frequently found in tropic areas, but Pan American reports excellent two-way communications out to 500 mi. from Ireland during a two-day period last August.

Specific short-term tests concern

BOAC Sales Shift

New York-Bangkok Overseas Airways Corp. has requested an E. S. sales agreement in a move to strengthen sales efforts to fill expanded seat capacity in 1960.

Three separate sales contracts were approved, effective Jan. 1, for Eastern states Central states and Pacific states respectively. In addition, a sales manager agent service, has been appointed to develop road traffic in the Americas, Indonesia and the Caribbean.

The British carrier also is considering the opening of a number of new ticket and sales offices in key U. S. cities.

ally is expanding, more frequently in the government path than in the integrated path, flying is not always at extreme ranges and distances, but not always, results in loss of intelligibility.

The link system, located along the coast at an elevation of 300 ft., employs an array of eight vertically stacked, circularly polarized antennas mounted on a 100 ft. tower. This provides vertically polarized radiation with a vertical beamwidth of about 3 deg., a horizontal beamwidth of about 15 deg.

The transmitter used in the output and two receivers are products of Telecommunications, Ltd. The receiver has

a sensitivity of 0.3 microvolt for 10 new output, a signal-to-noise ratio of 18 db for one successful input and a noise figure of 6 db. Bandwidth is 10 to 20 db down.

The transmitter at San Francisco and the one to be installed at Beirut also are used in line system. Both are products of Aeromarine Communications, Inc., of Coast Grove, Fla.

Pan American engineers developed the installation for the airborne VHF receiver which uses two cascade channels to lower the noise figure from about 14 db to around 1 db. Modification, which was performed by the airline, costs around \$100 per set, the carrier reports. Radio Radio recently has installed one of its RAVI systems for troposcatter operation and issued it to Pan American for evaluation.

Although the Ballyvaughan system presently serves its service customers in Pan American, at least one other North Atlantic carrier is contemplating the adoption of tropo scatter and the use of the Irish facilities.

Meanwhile, Pan American is continuing its investigation of ground-to-air tropo scatter to determine what improvements could provide consistent coverage out to 600 mi. This possibility, the use of two vertically stacked antennas on the aircraft instead of the single antenna now employed.



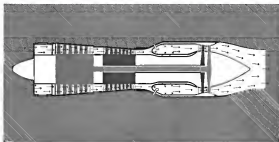
Five Boeing Jet Transports Readied for First Flights

Boeing 707 jet transports ordered by two airlines and two U. S. airlines are being prepared for maiden flights at Boeing Airplane Co.'s Renton, Wash., Transport Division plant. The transports, four for British United 700 western routes, two for American West Coast routes and Boeing Airplane. Boeing added out its 30th 707 late in December. About 100 are in service.

Olympus turbojet – high power, low fuel consumption superb handling qualities, great development potential . . .



...ANOTHER ENGINEERING ADVANCE BY BRISTOL SIDDELEY



One of the largest manufacturers of motor power units in the world, Bristol Siddeley Engines Limited produce the Olympus. The Olympus is one of the most powerful and efficient high thrust turbojets in service anywhere and therefore most performance details are severely restricted. It can be said, however, that the Olympus possesses outstanding handling qualities: in a short acceleration to full power from ground idling it considerably better the official requirement. It also has one of the lowest specific fuel consumptions and the highest thrust/weight ratio of any type-tested aero engine in its class.

The Olympus uses its excellent electrical performance to the two speed compressor system, pioneered by Bristol Siddeley and now adopted by the leading aero engine producers in Britain and the USA. Proof of Olympus reliability is given by the fact that it already has the longest overhead life of any British fighter or bomber

powerplant. And the series has been proved to have enormous development potential. The first production version delivered 11,000-lb thrust dry, while the current engine makes 17,000-lb thrust dry (24,000-lb with fully variable exhaust). Even more advanced Olympus versions are rated at 30,000-lb with reheat.

Olympus applications

The Bristol Siddeley Olympus is ideally suited to operation at transonic and supersonic speeds. The Hawk 91 gives the Avro Vulcan B.2 V-bomber an all-round performance unsurpassed by any other aircraft of its type. The Olympus has also been selected for the very advanced Vickers/English Electric TSR-2, the RAF's new tactical support/interceptor/strike aircraft. Other Olympus versions are under active consideration for the near generation of civil jetliners—the supersonic transports.



BRISTOL SIDDELEY ENGINES LIMITED

Bristol Aero-Industries Limited, 300 International Aviation Building, Montreal 2, Telephone: Université 6-5001

AIRLINE OBSERVER

► Soviet Union is still holding off any approach to the U.S. toward negotiating a bilateral air transport agreement covering a New York-Moscow route and probably will make no such move until it is clear that the airline that will match its routes already now operated by U.S. carriers on long-haul routes. Indications are that the Tu-114 turbojet—currently Russia's contender for long-haul international routes—is still having technical troubles, ordering around gear boxes transmitting power from the 12,000-shp turbojet engines to the communicating 10-ft-diameter propellers. The Tu-114 was scheduled to enter domestic Soviet service last fall but is still not operational as regularly-scheduled trans-Siberian service.

► Watch for early creation of an industry-wide statement committee on a national scale—probably by the end of the month. Aim is to establish some standards for all airports. Federal Aviation Agency would not be represented on the committee since it will be making the regulations in the field, but the agency would consult and cooperate with the committee. Brig. Gen. Jack R. Cross, USMC (ret.) (see p. 111) who is special consultant to the Air Transport Assn. on some statements, is organizing the committee, which will include manufacturers and other segments of the aviation industry.

► Chances are strong that the transportation industry's fight to eliminate federal transportation tax equity may be undermined by determination of the Budget Bureau to block the reduction of the present 10% tax to 5% scheduled to be effective June 30 under legislation enacted by Congress last year.

► Airline stocks listed on the New York Stock Exchange started sharply in the decline in stock prices which dominated market activity early last week. Of the 10 transline carriers listed on the board, 8 were at or below their 1959-60 lows at a single day. The sharp drops were interpreted generally as a decision which were spread throughout the list, but several brokers suggested that airline company stocks were reacting to a move by mutual funds to replace low-risk stocks with high-income securities (AW Jan. 4, p. 12). An index involved in the decline was American, Capital, Delta, Eastern, National and Northwest.

► Freeholders in negotiations between France and Australia over the future of France's air transport rights into Sydney for the private and French carrier TAI on the Paris-New Caledonia-Denver-Australia segment of France's proposed around-the-world service (AW Nov. 9, p. 59) has forced the French carrier to surrender its traffic rights in Christchurch, which it previously secured under a previous agreement. The carrier now lands at Dunedin on scheduled flights for refueling purposes only.

► Shoring up of income in write-offs for depreciation is drawing concern from airline financial experts. Such costs, which are also absorbed and will continue to climb, are expected to cut deeply into airlines' profits. Coupled with actual interest costs on long-term debt, the high depreciation cost is expected to depress earnings as more new equipment is delivered throughout the year (AW Dec. 14, p. 35).

► Current Division of General Dynamics Corp. is studying use of boundary layer control on the Convair 440 jet transport and has asked contractors for proposals on a turbo-propeller jet for the system. First two production units are to be delivered by Nov. 8. Output of the system is to be 11.5 ft/sec. It is to be used for 2 min at takeoff and 1 min on landing.

► Cuban Transit Commission, in a drastic move to increase at least some of the lucrative U.S. tourist revenues lost since the capitulation of the Batista government in Fidel Castro, has asked out an arrangement with the Hotel of Havana organization that will permit a rebate of one-half of the advance of Havana-class passengers who spend at least four days in a Havana hotel. Passengers show the hotel their advance tickets when checking out and are automatically refunded one-half of the fee between the U.S. and Cuba.

SHORTLINES

► Boeing Airplane Co. reports Model 707 turbojet transports have caused over two million passengers since they were introduced in airline service 14 months ago. By early January, Boeing Transair, Boeing Transworld and Boeing Transworld had completed assembly of the 100th 707. There are now 60 of the second in service with U.S. and foreign airlines. In 1959, 707s logged over 48 million hours in more than 115,000 hr., carrying 1,550,000 passengers. The model 707-100 passengers were carried from Oct. 26, 1958, to the end of this year.

► Irish Air Lines has changed its name to Irish International Airlines to more properly indicate the scope of its operations to the U.S. and 25 European cities. The name change is effective immediately.

► Lockheed Aircraft Corp., in reporting financial figures for the Electron turbojet transport, says Eastern Air Lines, the largest Electron operator, carried approximately 1.25 million passengers during 1959. Eastern Airlines, second largest operator of the transport with 25 delivered and 10 in production, carried an estimated 117,000 passengers since 549 million passenger miles during 1959. Pacific Southwest Airlines carried 5,915 passengers in one day, Dec. 27, 1959, in its fleet of three Electrons in operation between San Diego, Los Angeles and San Francisco. Individually, 13 Electron had been delivered by the end of 1959 and had flown a total of 110,000 hr. Airlines now using the Electron include Eastern Air Lines, American Airlines, Pacific Southwest Airlines, KLM Royal Dutch Airlines, Northwest Airlines, Ansett/ANA of Australia, Cathay Pacific Airways, National Airlines, Braniff Airways, Western Air Lines, Transair Express Airways, Quebec Express Airways and Trans Australia Airlines.

► Midland Airlines carried a total of 548,188 passengers in 1959, a gain of 25.5% over 1958. The local service carrier logged 100,457,000 revenue passenger miles during the year, an increase of 26.1%, and had a 94.9% load factor in 1959, compared with 91.8% posted in 1958. The company reports its 31 aircraft flew 73,113 hr. during 1959.

► William C. Wolf Associates reports sales of used aircraft totaled \$18.1 million in 1959. The company sold 63 transports during the year, including Convair 440, 340, and 440s, Vickers Viscount 810 and Douglas DC-3B and DC-4 transports.



WHAT WAS SINGER DOING AT FORT MONMOUTH? In this instance, Singer was working with U.S. Army Signal Corps engineers to advance the state of infrared art. At Fort Monmouth, and other installations of American defense, representatives of the Singer Military Products Division, are in constant—and productive—touch. A division of The Singer Manufacturing Company, SMDP is composed of the Singer-Rodgerson, Diehl Manufacturing Company and HERS-Singer. A comprehensive brochure describing these engineering and production facilities is yours for the asking.



SINGER MILITARY PRODUCTS DIVISION

The Singer Manufacturing Company 300 Broadway, New York 6, N.Y.
A FORT MONMOUTH DIVISION

44-38861-1 (10-59) 100-000000-000000



TAC'S Four Hercules fly their Lockheed Hercules C-130s in tight "diamond" formation. Engines give 300,000 lb. in aerobics.



AEROBIC pilots, all captains, include (from the left) Capt. Robert "Crew" Chesser, William Harsh, James Allen and Edward Moore, all members of the 774th Troop Carrier Sqdn. Below, jet engine noise is close to tail of the No. 2 airplane.



Aviation Week Pilot Report:

TAC Team

By Robert J. Stanfield

Sweet Air, Team—The Four Hercules of USAF's Tactical Air Command fly formation aerobics with a synchro-station precision and tightness that belies the size and weight of these four-engine, four-engine Lockheed C-130 Hercules.

Their demonstration—shown in this instance by American Wings pilots—on the firing in the air is not the four-plane formation—only only reflects the coordination and teamwork of troop carrier and combat cargo crew, but effectively demonstrates the performance capabilities of the C-130 (AW May 14, 1975, p. 62).

The Hercules fly close. From take-off in "diamond" where the airplanes give about 100,000 lb. each at cruise speed of 100 kt—they fly tightly in through a series of formation changes maneuvering highlighted by a bank-turn and go-around, and concluded by a tight circle for the last to touchdown.

Their usual 21-man, routine run to 3 hr. 45 min. during a one-pointed flight from the Army's Ft. Campbell, Ky., where, about 55 mi. to the north-west of Scott, where TAC's C-130s, equipped 519th Air Division run many of its airborne missions. It's a mission-planner but it's bound to give the respect of the professional pilot. The four-engine formation from the stars in Lockheed's new color movie, "The Four Hercules Story" filmed recently at Williams AFB, near Phoenix, Ariz.

AERONAUTICAL ENGINEERING



ARROW formation shows the four C-130s in a slightly stepped up "V" shape. Straight line is held tight during maneuvers.

Flies C-130s in Air Show Formations

Factors contributing to the performance of this demonstration include:

- **The pilots.** Members of the 774th Troop Carrier Sqdn, 465d Troop Carrier Wing, all are instructor pilots and aircraft commanders. Average flying time is about 4,000 hr. (1,300 hr. in C-130s) Team captain is Capt. Robert "Crew" Chesser, who flies No. 1 (left wing). Capt. David Moore flies lead aircraft and Capt. James Allen holds the No. 2 position (right wing). Third in the line is Capt. William Harsh. Also note is Capt. Hans Bauer, who flies close during the flight.

- **The crew.** All crew members are volunteers. Captain van, and include a structure pilot and aircraft commander. Along on the demonstration were Capt. Robert Seale and David

Stewart. Lt. Joseph Martin and Vincent Hughes accompanied by the 774th Sqdn commander, Lt. Col. Oscar Roberts and Lt. Col. Kenneth Corkins. Flight engineers included 1st Sgt. Dennis Lister, Willie Woods, Richard Stevenson, James Smith and Charles Kessel. On the top are 1st Sgt. John Linder, James Rowe and Don Nadeau.

- **The airplane.** Lockheed's C-130, which can operate in and out of a 2,700-ft strip (about 1,000 ft) and precise response to control application. The airplane literally, keeps ahead with out the power reverse. The "A" model is powered by four Allison T56-A-5 turbo-propellers generating 3,710 chp. at take off. The "B" model is Allison T56-A-7A engines of 4,150 chp. each at takeoff.

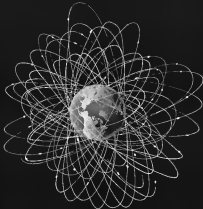
Maximum gross weights are 124,200 and 131,000 lb., respectively. Hercules prefer the "A" in their desert stations, feeling it responds better to power application than the "B." Its three-bladed propeller turns 1,100 rpm. against 1,815 rpm for the four-bladed "B" propeller, and to be more of a "coarse propeller" than a "power propeller."

- **The command.** High caliber of precision flying and teamwork is standard procedure with TAC's combat flight team, in this instance, the 824th Air Division, commanded by Col. Albert V. Enders, of which the 15th and 465d Troop Carrier Wings are commanded, respectively, by Col. Daniel P. Rahn and Col. George G. Narva. These are the sole U.S. based TAC units to



SEVEN-EIGHT formation, followed by a line break to touchdown, readily concludes the 21-man, aerobics demonstration.

PHASED ARRAYS



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5800. TTT (radio) and (computer). Others would go enough to get it, but wouldn't exceed 9770. TTT. (Glossol would be at about 120 ft).

Normal today carrier procedure calls for a 15-sec. interval between takeoff roll of each aircraft. In battle procedure an event the leader knows a fact. The team formation as they are a 3-sec. interval, but the team would to capture. They roll in a circle. There was a bit of battle procedure in No. 2 caught some jetpack and turned left, then right again. All aircraft were moving fast.

The jet airplane was airborne first, carrying payload at 100 ft off after about 1,500 ft. of run, holding nose high at 300 ft. in the other three, pulled off the leader at 100 ft. and were flying out of the leader's wingspan. Landing gear were retracted on pull-off. Fast rolled up, and the group in perfect "diamond" passed over the end of the runway at 1,500 ft. altitude climbing 1,000 ft. in 120 ft.

Swinging around in a shallow bank of 15 deg., the four planes descend fast so time in reaching 3,000 ft. was—except for the bomb-burst—most of the audience were disappointed. Shortly after the formation, altitude would cover a vertical area of from 500 ft. to 5,000 ft. at speeds that was 100 ft. This day's inclement weather suggested the low level work.

Once locked off, the formation was radial to and was closed up there was little throttle pulsing. At this altitude air fuel flow was 1,500 lb./hr./engine. TTT was about 1800 for the two jets. Two jets, 11,000 psi. Fuel control stopped was 290 ft. Aircraft are restricted at sea level to 100 ft. radial (100 mph).

Close Formation

The jet airplane held as close as 7 ft. from the leader's tail. We could read the last three digits of its radial from box, on either side of the box, vertical in. Counting the aircraft would be a crash. A line extending across the wings of the lead aircraft would have run across the nose of each wing over. Should either No. 2 or No. 3 have washed forward too far, a low tail of their wing tips would have dipped across those of the leader's, they flew slightly higher.

The nose of the jet airplane, tucked in the formation—on a nondescript low line with the top one-third of the leader's fuselage above of the arrangement of the two wing aircraft. Looking ahead and down the lead airplane appeared to resemble a large propeller pointing.

At a team the formation only got about 6 ft. a search pattern. This arrangement evolved from first flight together in six weeks. They first learned

up in 1957 and, when they first learned, are possibly distinguishable only by their outlines—a silver hence lead on a black background, with the Roman numeral IV—small pitch over on standard for the flying with.

Even so, the team performance was close in perfect manner. The result of more hours of practice plus the of facts contributed to subtle and complex maneuvers. Training and polish are, only according to living safety principles. Every shift of position, every change of attitude, or heading is preceded by a verbal action from the leader. Formation, stand by, for 100 deg. left turn, "Vand".

Formation stand by to go arrow. Go arrow?

Formation arrow—was indicated to 200 ft. indicated for search pattern. The first under the three aircraft. The group passed so close to the left C-130 that it seemed part of the formation. At one point, passing beneath with about 50 ft. separation, was noted that the whole column lights dimmed. The speed range close, which held the close airplane's speed to 150 ft.

Switching from "diamond" to the single file "nose" formation, the big B-57s showed a considerable change in position capabilities and its efficient low control motion (hydraulic boost screw blades in sections, clusters and sudden that made for ease of pilot handling.

Going to "nose" (as command), the lead airplane held constant. No. 2 decelerated fast and slipped an behind, slightly above. No. 3 moved, smoothly, in the rear and slightly above No. 2. Short, which had moved back, pulled up right against No. 1, whose lead had been of the circle around, so straight on the low. Capt. Bill Huth held the jet point, behind the end of this array.

From "nose" the group moved to the "caterpillar". The first two aircraft held their position. No. 3 moved to the left wing on No. 2's left aircraft (No. 4) also moved up to be off No. 2's right wing, which seemed only about 15 ft. away from the cockpit.

Ending Back

Turning back to "diamond", No. 3 aircraft quickly moved forward, sliding in to the leader. No. 2 moved out to the right, and up, as the jet airplane decelerated slightly, skidding left, then came back up the dot position. There was no second circle, and no search space. The transformation was accomplished smoothly, and in a twinkling.

As all military pilots know, flying tight and changing formations requires much thought and caution. Pilots must be alert to even minor mishaps. They must watch their instruments but must constantly keep their eyes on the air around

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place to which they are holding. The leader alone can look about. Single-pilot, single-engine airplanes are most important, it is assumed that these big, fast-cruiser turbojets can be located like laser light.

The toughest job of the two is that of the No. 3 complete pilot. Remaining

on the left of the formation, he must do with his head turned right, looking past his cockpit to ascertain a clear, positive status, in a steep bank, can be a most disorienting possibility. Turbulence from a second aircraft's aft TAC pilots and the aircraft commander can be spalled by their capacity, over the

long stretch a "baseline" is necessary. From "diamond" to "rebelion right," the leader and No. 2 hold their positions. But G-91's "diamond" status, however, had to move definitely and quickly. Flung off the leader's left wing, he moved out, 'd right then up into No. 2 position of the staggered echelon. That position, which usually has been right, closed as the G-91's wing as he came up. There was a bit of throttle-squealing here, results was a fast break. These pilots are not the Standard driver type.

The backseat—a lightly powered maneuver which is now labeled the "Hornet-hunt"—only for a moment while left on a quick trip to the ceiling. Back from the "diamond" a combined a combination four-plane rapid turn, leading change and altitude gain (1,000 ft), then a fast recovery to "diamond." For obvious reasons, the final command is given from the slot airplane.

Still holding at 1,800 ft., the leader noted that the formation was "ready to break." But attack signal began to come off 18 sec. later. With three seconds left to go, pilot Hatfield called the maneuver "Stand by—10 seconds." Now!

Slot airplane shot up 30 feet and steeped 45 deg. left. Two seconds couldn't see the other three, which also were heading up at 6,000 fpm. plus from the "diamond." The leader also sharply pulled up and 45 deg. to the right. No. 2 went 80 deg. right. No. 3 went 90 deg. left. There was no power increase in the "burst"—just a sharp pull up and back.

Predetermined heading

At 5,500 ft., still heading up, all aircraft turned back to the predetermined heading. At 6,000 ft., leveled off, all four quickly turned back into "diamond." leader at this point calling off the intended speed "230—230—" etc. This was a beautiful coordinated maneuver: a fast banking, well-paced set of flying done with the precision of the professional aviator.

Formation changes were continued during the action as Ft. Campbell delivers new report coming on at 6,000 ft., formation and up to 10,000 ft. Visibility at the field was just over a mile, with rising in the formation right column—moved up as the active runway at 2,000 ft. altitude. "Fly back!" was ordered over the end of the runway, leader calling "On go!" and all four aircraft banking to the left. Gas was lowered but very soon the break and airplane was brought in, the early light in bank, to touch down on alternate sides of the runway. Timing was fast, not due to the leading aircraft behind. By the time the 5th's airplane (the chase)



First Photos of Fiat G.91 Armament

First photographs of special German armament installation on Fiat G.91R reconnaissance version of lightweight strike fighter (AW Jan. 11, p. 46) show one of two Werns, DEFA Type 102 modular camera which replace the standard archipelago installation of other G.91s. DEFA camera is mounted on German Messer design, and is similar to NATO format. It is built in the Belgium and France, and is the first in the new country which uses the Messer design. German installation was different concept from Italian scheme, looking at gun fired in the leading structure instead of mounted on nose/pilot. First over armament has easily provides access to archipelago camera and its associated lens, shown at upper left of lens (top plate). Standard installation is two pairs of 0.50-cal. machine guns, (below) mounted with their mounting base on removable pylon covering the forward armament bay. Firsts can interchangeably lens plate to place and make it possible to pull a fixed installation and replace it with a full-charged one in a few minutes (AW Jan. 23, 1970, p. 18).



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Stainless 347	E 347	Stainless 347	E 347 L
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A HIGHLIGHT ON CREATIVE SYSTEMS ENGINEERING AT



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Front page projects of tomorrow are part of the picture at

was on the deck, the first was moving toward the bow-end two steps.

There were no engine problems or malfunctions during this most demanding situation, although the Hercules here experienced engine failures which did not disrupt the mission. The team also is quick to point out that their flying is daily representative of the troop on the spot. All in about early '80s, they also feel that their biggest lesson is 404th Wing Commander Col. George C. Norman.

The C-130A and the "B" are some major items together in formation flights from Saigon AFB and Ft. Campbell, but not in mixed elements. Crews usually number five, and the aircraft are operated in "lighter" configurations (lower operational costs and equipment for maximum speed) for the majority of the time, electronic tactics systems can be flown in a great many configurations, including the use of high performance loads.

Operating Weights

For example, the C-130A, at its operating weight of 75,500 lb., with a 22,700 lb. load, has a range of 1,677 statute mi. with 4,100 lb. fuel reserve, with zero fuel the range is 3,187 statute mi.

Carrying a 16,700 lb. load with 2,700 lb. fuel reserve, range for the "B" is 1,877 statute mi., at zero fuel this increases to 3,667 statute mi.

At its operating weight of 70,100 lb., and carrying a 22,700 lb. load, with 4,200 lb. fuel reserve, the C-130A has a range of 3,117 statute mi. which, with zero fuel, jumps to 3,187 statute mi. With a 16,700 lb. load, at the same operating weight, range with 3,800 lb. fuel reserve is 3,800 statute mi. With zero fuel range extends to 3,187 statute mi.

The "B" will outperform the "A" model by about 30 ft. at speeds in the 400-450 mph range at 10-12,000 ft. and 25,000 ft. Flying at the same altitude, with the same power setting, there is only a 5-ft. speed difference in favor of the C-130B.

Even handling characteristics of the Hercules were chosen by Avionics West during an IFR (instrument flight rules) flight in the C-130B. At 25,000 ft., outside air temperature minus 10°C, the airplane indicated 210 lb. for a true speed of 315 kt. During cruise at this altitude TTT was 550C, torque was 9,000 ps. per engine. Fuel flow was 1,000 lb./hr./engine.

When the line accelerated during the flight, and this was broken off via but air, utilized for landing angles. While during the merged dropped of about 10 ft., but an application nearly results in a loss of 5,000 lb. of torque, means the aircraft

German Weld Process To Be Marketed Here

Wholesome Looks Com-North American rights to a versatile electron beam process for machining as welding hard metals have been obtained by Hamilton Standard, a division of United Aircraft Corp., according to the company.

In discussing the agreement, Charles M. Koenig, general manager of Hamilton Standard, said the acquisition of the process was the firm's first major step outside the machine field though it has been steadily developing within the field.

The process and the equipment for it, developed by the Carl Zeiss Foundation of Ulm, Germany, "Prof. Gossauer," can be used to cut holes in, surface treat, melt or weld almost any hard material including tungsten and the exotic non-metals according to Hamilton Standard. The equipment, to be sold here as the Hamilton Zeiss Electron Beam Machine, is said to have welded through stainless steel in one step in a few seconds during laboratory tests.

Under terms of the agreement between the two firms, Hamilton Standard will start manufacturing the machine that says Hamilton Electronics Inc., New York City, jointly owned by United Aircraft, the Zeiss Foundation and Irving Ramm of Marzetta, N. Y., will market it. Koenig is general manager and John F. Sullivan, former Hamilton Standard national manager, has been elected president. John C. Sterling, Jr. has been named project manager.

The electron beam process, which physically as the electron changes matter with a controlled high-density stream of electrons, consists of an electron gun, a vacuum chamber and work table, a high vacuum pumping system, an electronic control system, high-voltage power supply and associated monitoring equipment.

Hamilton Standard engineers said that a welding machine the equipment would produce a section 4-6/16 to thick from sheet stock at two feet a minute. It can butt-weld at a maximum rate of 4 in. a second, they said. It performs these operations without distortion of the piece and with maximum gas growth in the weld area.

Hamilton Standard has completed negotiations to purchase 50% interest in Microbeam, Inc., of Davis, Calif., manufacturer of electron microscopy, applied and analytical testing instruments, non-destructive and corrosion measurement. Microbeam will be granted license to manufacture individual units of Hamilton Standard's line of jet equipment.



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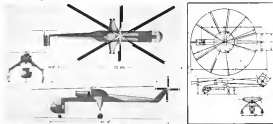


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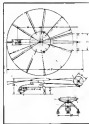


Latest configuration of the S-64, featuring power-vent development of the gas-turbine engine S-64 being used, is shown in an actual development photograph under construction on the General Electric T64 and the Pratt & Whitney T113. Picked in 10 days; price: 15.7 tons.

Sikorsky Shows S-64 Changes, Studies for Future



Three views of the S-64 show changes from earlier studies: addition of a sixth rotor blade engine mounted on top rather than at the side of the fuselage; droop cockpit for two-level seating; Y-shaped landing gear struts. Swivel seat for the pilot, by which he could lean forward for normal flight or backward for cargo handling, has been dropped. Lowered seating for the operator provides better visibility for cargo handling.



Another configuration of the 42-hp gas turbine (left and right) has a somewhat different engine layout. Here they are mounted above the top of the fuselage just ahead of the rotor hub.



Helicopters, concepts for the future (AW, Feb. 2, p. 65) include the S-57, a delta-wing rotary aircraft (AW, May 4, p. 67) with a one-blade rotatable rotor. More landing gear networks into wingtip pods. Picked on the ground (left to right) are an autonomous surface drone helicopter, a compound helicopter to carry 10-15 passengers, a delta-wing vehicle and a tilt-wing vehicle. The vehicle flying at the extreme upper right is a concept for the Ka-50, a rotary-wing autonomous helicopter (AW, Aug. 17, p. 14).



Development of its flying state to a gross weight of 42.5 tons to carry a payload outside the period of a maximum of 21.5 tons is being studied by Sikorsky Aircraft Division of United Aircraft Corp. Latest configuration calls for using four Pratt & Whitney T113 turbine engines pushed in pairs outboard of the fuselage. The 100-hp diameter rotor is made up of 11 blades and a logic rotor hub facing to rubber dog. Two tail rotor counter-rotors can be seen more clearly in the three views (below, right on the previous page).



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Ka-18 four-place coaxial helicopter, derived from two-place Ka-14 designed by Nikolai Kaman. Drawing shows: (1) opening for stator blades; (2) forward wheel; (3) pedal controls; (4) pilot seat; (5) shock absorber; (6) pilot seat; (7) reflector; (8) fuel tank; (9) forward fuel tank; (10) shock absorber; (11) left main wheel; (12) engine housing; (13) anti-rotation mechanism; (14) rear fuel tank; (15) oil tank; (16) oil tank; (17) rotor; (18) rotor; (19) rotor; (20) rotor; (21) rotor; (22) rotor; (23) rotor; (24) rotor; (25) rotor; (26) rotor; (27) rotor; (28) rotor.

Design Details of Ka-18 Four-Place Helicopter



Upper rotor (above) turns clockwise, lower rotor (right) turns counterclockwise. Helicopter problem is at bottom of rotor mast. Designer N. Kaman saw the helicopter crash at 110-120 km per hour (100-120 mph). Several have claimed 300 km, shock wave record of 300 km, covering two points (AW July 27, p. 97) probably using a 275 hp engine.





TITAN STAGE II transport is suitable to 60 mph, and withstands rugged conditions.

Part II: Titan ICBM Operation

Hardened Titan Bases Require Specialized

By Russell Howes

(This is the second of two articles detailing the operation of the USAF Minuteman underground ballistic missile support program developed by the Martin Co.)

Desert, Calif.—Operation from hardened bases entails requirements for scheduled 30-day periods underground survival special problems of ground support for the system design team of USAF's Minuteman BOMBS. Titan intercontinental ballistic missile.

A Titan base typically will be equipped with one missile assigned to three-month complexes. The three main pieces in the base will constitute a squadron. Everything is underground and protected by two or three feet of concrete including living quarters, food and all other provisions for survival, as well as propulsion design, electrical power supply, launchers and all wiring and plumbing.

Requirements imposed by the hardened base environment include separate air search filtered against radiation, constructed material for personnel, seven diesel generators in the power house and for cooling of electronic equipment.

Missile launchers and ground-based guidance systems are mounted upon elevators to raise them from their underground silos for launching operation.

Facilities account for more than a third of the cost of a complete operational base, and ground support equipment for another third. The other third



BOTH STAGES of Minuteman Titan are loaded

shared a Douglas C-119 at Denver for shipment to Cape Canaveral, Fla., for flight test. C-119 accommodates the stages without modification.

Support

provides for the main missiles and other airborne elements of the system.

In most cases, underground complexes will be built by grouping out a second pit, 165-ft deep, reflecting it in a level, 160-ft deep floor. The silos floor will be erected there, using more or less conventional surface construction methods. What these are in place, filling will be combined with other elements of the system being constructed at different depths. Daniel, Mann, Johnson and Mendenhall and Associates holds the contract for operational facilities.

Titan base, TI, at Lower AFB near Denver the first to go on an operational footing, is scheduled to be ready in 1961. Operational Sprinter, Test Facility, (OSTF) and training base, TI-4 at Vandenberg AFB, Calif., will be in service earlier, the former by late 1960. TI is a single missile silo, intended to provide a final test of the operational base equipment. When completed, TI-4 will be next to the operational test facility and the two sites will share the same power house and some other support facilities. Though it will resemble the land base design, OSTF was not actually withdrawn the 100 psi blast resistance artificially set as the dividing line between land and soft.

A fire test built on land base combined with the high ground support engineering problem has required the Titan system team to design more sophisticated means of data from conventional programs. The operational structure of Minuteman's part of the Titan



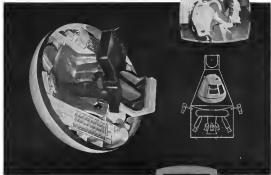
TITAN STAGE II is erected on roll of 160-ft high fabric at Minuteman for meeting USAF acceptance tests which cover all elements of a launch, short of propellant loading.



TRANSPORTER with Titan first stage is rolled onto center of test stand at Minuteman.

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system team reflects this as well as a close appreciation of the ground support problem. Martin-Denney has an Advanced Base Systems Department which is on a par aggressively with the Aeronautics Department which designed the aircraft itself.

In the past year, a group has been taken from Martin-Denney to form a corporate division of equal rank to handle design of ground support equipment and other electronic subsystems. Electronics Division has expanded and discharged responsibilities as well as detail design of operational launch control and checkout equipment. An other new corporate division of the Martin Co. known as Aeronautics Division, has been set up to play an integrating role and to correct that Times have not corrected and only to accept production orders in this logic to come off the bottom line.

Advanced Base Systems Department at Martin-Denney is very detailed in terms of technical capability to long about of the latest advances in the field. Detailed engineering is handled by the Electronics Division or subcontractors.

Martin holds the contract for the launch control and checkout system as well as for the missile itself. The reason is to provide an automatic periodic check of subsystem functioning as well as to allow testing prior to one tests during unscheduled maintenance or after an aborted launch. During the checkout sequence, subelements of portions of data are expected, operation is measured against a standard and a "go/no-go" indication is displayed at the control's launch checkout console. Display of the equipment status exists at its separable console level.

Operational equipment is on many aspects simpler than that used as the development program since there is no requirement to collect and reduce data. Three elements of three computers in the control center will be able to run a complete operational launch if there are no technical faults. Operational equipment will be used in American like those of the Navy. Communications network for operational launch will be designed and installed by Sylvania. Carlsons, except in the case of Vandenberg AFB, where the Kellogg-Brattin-Spaulding Co. will provide the communications network for CSTF and TTF-1.

Automatic controller for the propellant loading system is Avtron D. Little Co.

The cable control system, including the 1000-attenuation gain and transmission system, is being designed by Bell Telephone Laboratories and will be produced and installed by W. W. Electric Co., York, Pa.

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Budd DIVISION

checklist and launch control action is the launching itself. If the proper state of readiness exists, launch occurs from control of propellant loading, tank elevation, launch and return of the booster to a horizontal position. Preparation, readiness required by substitution in the countdown are not launched automatically by launch control equipment control and monitored by a single criterion. Elements of the total system to be checked in the launch sequence have been strategically selected to minimize the number of checks necessary to give an overall measure of system performance.

Control launch sequence controls launching equipment automatically. Operation of the flight control system launch control equipment is typically simple. It sets the flight control system program to the power status, time base and makes one quick check of the overall time loop equation. This is done by generating a dynamic input signal and summing all the individual outputs of the flight control system. Failure of test output to match the established criterion would light a no-go signal. If substitution would be required to the flight readiness condition and a more detailed checklist would be required to isolate the fault.

Timing of the propellant loading and pressurization system launch control equipment also is automatic. Sequence of events includes loading of oxidizer and propellant gases into the tankards, control of the pneumatic systems, pressurization of loaded propellant tanks, disconnect of propellant umbilicals and shutdown of the propellant loading and pressurization system of something in the launch sequence, supply action provides ground power to launch control systems.

This includes hydraulic as well as electrical output.

When the missile itself has switched over to internal power the access supply system continues to provide electric power. The firing of hold-down bolts and for disarming umbilicals. The fire control system launch control equipment separates the firing of that firing stage of the booster engine, after the automatic engine and controls the automatic starting system for the booster engine. Launch sequence is the automatic sequence when ground control sends either a function of time or count.

Flight control system checklist is given time as overall test of the system time loop time checking dynamically all of its system and control units. When a no-go signal appears, the equipment takes a roll call of replaceable modules until the last one is found. Specimen control signals for checks are



CRANE made by Kaiser Steel is second about 15 miles before a Titan II goes to Cape Canaveral. Propellant loading is complete except topping off liquid oxygen tanks in under 14 ppm. hold-off. Topping lines run through umbilical tower, which remains standing.

generated by controlled movement of service gys. Flight sequence unit is checked in timing it through its planned sequence and comparing outputs with pre-selected limits set up in the checklist equipment. Equipment continues to work through a list of tests until a go condition is obtained or a fault is isolated in the flight control or checklist action. Controls for verifying the automatic checklist sequence are based on the past record of one check.

Propellant Loading

Propellant loading and pressurization control checklist equipment tests ground propellant loading checks as well as the actions, part of the system and propellant loading and pressurization launch control equipment. Counting on checklist equipment to operate in sequence reliably are propellant loading and pressurization tasks. Propellant loading check is a do not test inputs permit to a not loading error can be regulated by man and materials. Values are preselected and monitored according to the phase of the loading cycle.

Access supply system checklist equipment tests ground 15 d.c. electrical supply, ground 450 cps electrical supply and ground hydraulic supply. Progress of the check is monitored through collection in the control center. Program sequence power units and monitor their status, pressurization. Ground-to-launch power transfer occurs in the access supply system

launch control equipment are based on monitoring usual, access power and operating transfer events. Successful power source also is used to change other information checklist equipment.

Engine control system checklist equipment performs a series of tests on engine control system, starting sequence, counts and delays sequence events. Some selections must be continually selected to maintain the counts in a state of readiness. Control and monitoring events for these functions are part of the checklist equipment. Access supply system flight control system and propellant loading and pressurization system checklist equipment all have similar functions. Launch control system checklist equipment must supply current to go to fuel to keep the system tests for a quick launch. Control control displays at launch are status signal from system, checklist information.

As part of the Titan commercial development program, prototype, open road ground support equipment is used in assembly and development launch operations at Cape Canaveral FL, and at various test stands here. It is because of this policy that Martin, while other contractors at Canaveral, use an assembly and development launch operations at Cape Canaveral FL, and at various test stands here. It is because of this policy that Martin, while other contractors at Canaveral, use an assembly and development launch operations at Cape Canaveral FL, and at various test stands here. It is because of this policy that Martin, while other contractors at Canaveral, use an assembly and development launch operations at Cape Canaveral FL, and at various test stands here.

Where EECo timing equipment counts



From the Atlantic to the Pacific whenever a missile leaves the launching pad odds are better than 5 to 1 that its instrumentation is being coordinated by timing signal systems made by Electronic Engineering Company of Coliforma. In the 10 short years since it first launched a busi-

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Timing System
- TELEPHON
Code Generator Systems
Time Code Generator

program, USAF decided to capexize on the existence of equipment ordered in the middle. At the heart of ground support equipment is the Master Operational Controller (MOC) at Cape Canaveral, it is the central control and monitoring point for all activities on a Titan pad. It carries out seven functions.

- Master sequencing
- Fluid flow control.
- Ejector control.
- Uniblocks control
- Ejector control.
- Water control.
- Timing.

Master segments in the NIOC automatically under specified ground support units to ease out the preparation steps during the countdown. The order and timing of the various checks and other post-launch steps is programmed long before the actual test when time is not a critical factor. It checks itself during the countdown to make sure the step sequence is keeping pace with the countdown.

Subsystem Checks

It is possible for MGC to run checks to verify performance of any substation or combination of substations before the countdown begins. These substation checks amount to a complete countdown sequence to see if all components work properly and to check some of the substations' operating parameters. If an automatic substation check finds a fault it notifies MGC which automatically calls a hold fire or an engine shutdown. If a hold fire calls an aborting step sequence, the master sequence can be recycled to the beginning of the sequence by a manual selector switch on the sequence control panel.

Topical solution checkers and oscillation valves in MOC are pressurization and prefiller control prefiller checkers, prefiller loading control valves, prefiller loading control valves, and the digital control system prefiller checkers. Pressurization and prefiller control checkers measure gas pressure to waste area to see adequate for proper feed flow and equipment operation. Pressure checkers are located in the prefiller tanks and checkers in the pressurization system. A check of liquid oxygen and fuel pump system pressure sensors or fails to verify the pressure values are displayed in detail to monitor as the console rather than through the use of gas logs. Ignition. Pressurized helium and nitrogen as well as fuel and liquid oxygen are supplied to the prefiller loading controller and

The controller generates values and

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shut off, power is provided by solar batteries plating the wing and body surfaces.

Inside the cockpit, living quarters are situated in the rim of a pressurized wheel like cabin which revolves to provide artificial gravity. Radio and radio antenna resolve with it. Tubular hydraulic "guides" on either side of the rim give signals to produce speed and high precision fuel.

The Atomic Pulse Rocket could transport payload to the Moon at \$6.74 per lb., less than one quarter the prevailing air

weight charges over equivalent distances. A similar project is past the preliminary stage in the Defense Department.

ARMAS, now providing the aerial guidance system for the **ATLAS** BOMBS and engaged in advanced research and development, is in the vanguard of the race to outer space. For this effort, **ARMAS** needs scientists and engineers experienced in electronics. **ARMAS**—Garden City, New York. A Division of American Bosch Arma Corporation.

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pumps in them, refines and sulfates data on local pressure flow, air, total flow, temperature and weight measurements. At the correct times, it usually starts and stops propellant transfer pumps. Pumps that down intensively during malfunction or emergency conditions. As well as performing preflight checkout functions, flight control preflight checks verify the selected portions of trajectory commands and verify correct operation of the program. Its fuel flow preflight tests include:

- Airborne hydraulic system, 51 and fluid tests.
- Main gas measurement.
- Flaring test.
- Lateral test.
- Check of displacement and rate gas.
- Distance response threshold test.
- Frequency response measurement.
- Structural feedback check.
- Flight control rate limit measurement.
- Flight control system program test.
- Comparison of sample output signals with known voltage references.

Storage facilities

Propellant supplies, high pressure gas, conditioned as far as clean cooling, hydraulic power and control lines of electric power must be stored or processed within a reasonable distance of the launcher. Test stands at Martin-Denver have 25,000 gal. vacuum-picked, steel kegs that lay out oxygen tanks about 150 ft from the firing position. Liquid oxygen can be stored in this tank for long periods of time without losing more than 140 gal per day. Two 98 gal. gas. Carter turbine pumps run the change tank at need for the main tank. SE

A reusable pump capable of flow rates between one and 250 gpm is used for fine tank fill, and down all the ground transfer system and replacement of liquid oxygen vaporized during a hold. Main 51 lines go directly from storage tank to the engine. Liquid oxygen topping last go from the reusable pump to the engine tank via the umbilical system so that previous topping operation can continue after the vehicle has been launched.

A dump line to drain off excess liquid oxygen in the mode one, after return it to the storage tank or dump it at a waste holding pond to evaporate. If it dumps out, however, fuel is stored in two 30,000 gal. tanks near the launcher. Controlled transfer pump can pump fuel at 500 gpm. As fuel expenditure is too slow to require continuous pumping topping of main tank, it fuel fill lines are used in the engine. Controlled pump at its peak can be used to return fuel to the storage tank if a flowback is indicated. It could also

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Liquid Hydrogen Storage Sphere Installed

Liquid hydrogen storage sphere is installed at the new Test Area, Cape Canaveral, Fla., plant being built by Lockheed Corp., division of Union Carbide Corp. Plant will provide up to 3,500,000 lb of liquid hydrogen annually for National Aeronautics and Space Administration. Sphere will hold up to 20,000 lb for transfer to tank and delivery tank cars.

be dropped and burned as a reusable building joint.

Five slings are used to provide balance and support at high pressure to the remote and some stress of ground support equipment. Three of the bottles contain nitrogen and two contain helium. All are loaded by the gas generator building. Each will withstand an internal pressure of 3,500 psi and the helium containment and nitrogen capsules will pressure them to that level. Pressure is stepped down to lower values before distribution to the motor, auxiliary power and ground support equipment units. Motor electronic equipment is continuously run at a 75% of conditioning level in the test vessel or motor. Without this, failure rate of the electronic components during the long test operation would be much higher. Checkout equipment at test area identical at Martin-Durham test site and at White Sands Missile Range, Cape Canaveral.

Test was designed from the outset to be mobile and as transportable

Each stage is moved on a specially designed mobile launcher as a transporter built to Martin specifications in North American Aviation. When moving by road, the transporter is designed for speeds up to 60 mph. Test tank, shown in photo, is the first being moved. Towing vehicle is a 21-ton, 6 x 6 truck. Test and its transporter were designed to fit within the internal dimensions of a Douglas C-119 (AW No. 71, p. 14). Martin built Titan as the first ICBM originally designed to be as transportable. Transporters for the two stages are quite similar except for the different wheel bases and slightly different axle spacings designed to meet different vehicle requirements. Forward end of stage one is supported in transport by a single assembly, while the aft end rests on solid supports. Forward ring members rest upon a pair of steel, mounted roller supports on the transporter. This arrangement isolates the stage from removal vibrations of the transporter on the road and allows length variations in the stage.

The second stage, when in use, remains at rest and is not the stage one is moved upon the transporter. Its own support, checks of pressure, flight control system, etc. While all the transporter are mounted upon aircraft type shock struts which can be lengthened or shortened by a hydraulic system for loading into a C-119 or to allow clearance of low underground when rail transport is used. A desiccant container in each transporter is linked to the main tanks to reduce the humidity of circulated air, eliminating the danger of corrosion in water condensed out of the air.

When erected near Cape Canaveral and Martin test stands in Denver, a rigid frame of structural steel mounted on pivots at the base to allow the reactor to a horizontal or vertical position.

Erection process consists of bracing the transporter causing the first stage, inside the lowered reactor where support cables are connected to the stage. Transporter is driven as then released the shock struts are shortened and the transporter is pulled out from beneath the stage. Next stage and cables are then attached to the stage to hold it steady as the reactor is used to the vertical position. One cable is run from the main hoist at the top of the reactor and attached to the forward end of the stage to keep it from slipping off in the center. When the motor and inside stage have been lifted vertical, all supports except the vertical one are removed and the stage is lowered into the advance thrust motor by the main hoist.

Erector Lowered

When both-down stage one of the thrust motor has been lowered stage one, the vertical support is removed and the reactor is lowered into its position. The stage two transporter for stage two is moved into the motor and the reaction pressure is similar to that for stage one, except that the stage is lowered into the existing structure on top of stage one. This then starts the launcher thrust motor.

The reactor is moved to the vertical by a block and tackle arrangement as well as a motor-driven cable system. A warning alarm when the stage is attached to the two reactor motor area. An auxiliary in double column under the left of the reactor is it gives the balance point. Leg locks hold the reactor as it is in the vertical position.

There are seven work platforms in the reactor which can be folded down by hydraulic actuators when the reactor is in the vertical position. The number of work platforms will be reduced in the in the operational use launcher. The reactor has a pressure indicator, a water damage system for the protection



The nation's first fully-operational portable digital telecommunication (PCM) systems are in the air now in high-performance jet aircraft providing accuracy, versatility, and dependability never before known in electronic test data gathering.

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nage tape storage, and simultaneously transmit digitally over a telecommunication link.

Related compatible Episco ground receiving systems also in operation now process previously tape recordings of the teletransmitted PCM data and received stored data in computer format. In addition, non-automatic editing and "query-book" real-time visual monitoring of the test data is provided in both digital and analog form. These systems are completely compatible with the recently established IRIG PCM Telemetry Standards.

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GPL research

Nuclear Gyros

GPL research is now studying for the U. S. Air Force, the feasibility of harnessing the most efficient gyro known to science—the nucleus of the atom. Development of such a gyro—independently accurate, perfectly balanced, friction and maintenance free—will revolutionize space reference, navigation and guidance techniques.

The nuclear gyro is just one of many projects now underway at GPL research. Others include: **Self-lighting as the moon • Passive position fix timing • Laser amplifiers • Pulsed radar systems • Electronically scanning radar antennas • Space velocity measuring systems • "Multi-Mode" airborne systems • Orbital and launch clearance radar • Advanced digital and data handling techniques**

These, plus continuing research in radar, computer and data handling theory, reflect a part of the breadth of GPL's undiverted investment in the future.

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AVIONICS

Thermoplastic Recording's Uses Studied

By Ross Miller

New York—High-density airborne records, comparable in size and weight to magnetic systems, now evolve from soil on thermoplastic recording now being conducted by General Electric Co.

The capability of high storage density, combined with film scrubability makes the new recording technique (AV Jan 4, p. 24) superior for stable and spare vehicles where weight and space is at a premium, according to George Hilder, vice president and general manager of General Electric's Defense Electronics Division.

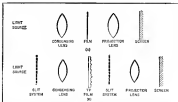
High storage density could increase sensor output, all on inherent computer or analog storage memory size.

Instantaneous Monitoring

Instantaneous monitoring, another possible feature of thermoplastic recording, should give the technique an advantage as aerial reconnaissance, Hilder says. An operator could observe recorded images immediately after they are taken and make notes when necessary.

Large, high-intensity radar displays which could be projected in color as another possible application. Hilder says the technique has a host of military applications in radar and signal detection, electronic countermeasures, missile guidance and communications.

A development model of a ther-



PREDICTOR of thermoplastic recording (left) differs from record projector (right) in location of the magnetic disk system which is not visible. Normal light from scanning the sensor illumination passing on the thermoplastic film, however, reflects light through the disk and projects less images on the screen.

moelastic recorder and an optical system for viewing black and white images recorded on thermoplastic tape were revealed here last week by General Electric.

Meanwhile, Ampex Corp., a major manufacturer of magnetic tape recording devices, reported it has been studying thermoplastic recording and other new recording techniques for several years.

Thermoplastic recording combines the processing speed and much of the flexibility of magnetic recording with the storage capacity of photography and better color of these techniques to some aspects, according to Guy Sault, Ampex vice president and director of research.

The new technique can store 100 times more information in a given space than is possible with magnetic recording and the make a permanent record in a few milliseconds. Its resolution is comparable to that of photographic film.

Color Recordings

In comparing thermoplastic recording with photography, General Electric pointed out that both techniques permit viewing of black and white or color information and both require high-storage density capability. Only a black and white system was demonstrated but a color system is feasible, the firm said.

Furthermore, in contrast to photographic film, the new recording method

has three features. Thermoplastic film can be chemically processed almost instantaneously, thus eliminating chemical baths and the recording can be maintained continuously. The film can be erased by heating and reused again, a cycle that can be repeated thousands of times, and faster element handling is possible.

Potential Advantages

Thermoplastic recording has three potential advantages over magnetic recording:

- **Higher storage density**, by a factor of 100 to 1. Several dozen megabits might be stored on a single square inch of thermoplastic material.
- **Higher maximum recordable frequency** is a factor of 10 to 1. A 20-sec. writing rate is conceivable.
- **Predictor processing** as well as electronic.

General Electric declined to identify one of the thermoplastic materials—plastics with low melting points—which it is using, but said any that a customer can develop.

Information is written by an electron beam on a three-layer medium consisting of a thermoplastic film, less than 1/2 in. thick, deposited over a transparent conducting film which carries the heat, an ordinary plastic tape is the General Electric demonstration. Thickness of the entire three-layer film is several mils, a figure which the company hopes to reduce further. The thermoplastic material could be adjusted to



TWO-HOUR TV show recorded on 1/2 in. of thermoplastic tape is held by Dr. William E. Glass of GE behind magnetic tape now easy to record the same program.



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glass or metal flat plate as shown above.

That is, the electrostatic film, while the higher melting point solvents remain solid. Electrostatic forces between the charge patterns on the film and the ground plane deform the thermoplastic during the compression, liquid state. After the film passes the electrodes it hardens and preserves the deformation in its surface.

Amplitude and frequency of the applied signal determine the depth and the spacing, respectively, between deformations. The complete process—changing of the film, its growth from the solid into the liquid state, the deformation of the film by electrostatic forces and

the hardening or "burning" of the deformations into the film as the heat diffuses into the bulk after passage beyond the electrodes—currents less than 10 milliamperes.

The displacement reactor is contained within a continuously pumped vacuum chamber, for higher working density and better speed. Its operation should not be disturbed by rapid ex-



steps. All executive. Sometimes just for a few extra minutes of recording time. The FR-480 eliminates this by doubling the recording time for any given bandwidth. It basically gives you the work of two conventional machines. You get the same wide bandwidth of 250 Hz at 60 cps in both. You get special applications. And every FR-480 tape is machine-to-machine compatible without flagging a note. Good reason why the FR-480 is the most versatile recorder you can use. A word from you will bring the full story. AMREX DATA PRODUCTS CO., 804 Quince Rd., Redwood City, Calif.

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2. Provides full electrical power on ground without operating main engine by using a source of compressed air.
3. Provides full electrical power in flight with a minimum use of bleed air for speed assistance. Full electrical power can be maintained on a gas-turbine engine by cross-bleeding air from operating engine.
4. The unit can be made self-contained on the ground or in the air by landing an Airesresearch gas turbine into the aircraft. This closed system within the aircraft allows

for three conditions listed above.
Other features: Extremely light weight... low oil leak capacity... self-contained, self-cooling lubrication system... high suspension operation... constant speed output full available for additional accessories... up to 120 KVA.

A high degree of dependability has been achieved by using a turbine, gear train and control system similar to that employed in production air turbine starters and air turbine motor built by Airesresearch which have accumulated thousands of hours of successful operation. Test engines are started.



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ing it. Another feature then enables the film out.

A tracing or projection system for the photographic recording differs from a standard projection system in that the former has a conjugate slit system. Namely, without the slit system, a light source is imaged in a condensing lens through a transparent into a projection lens which in turn images it on the screen. The photographic projection, however, consists of a slit system, which ultraviolet source and black light, a condensing lens, the photographic film, another slit system, a projection lens and the screen.

The slit system are conjugate so that in the absence of the proper film deformation light passing through the first slit system is focused on opaque lens of the second system, which effectively prevents light from reaching the screen.

Difference Grating

When the deformations in the film are in the form of a diffraction grating, the grating system light through the slit in the second slit system and is brought to a focus on the screen by the projection lens in a position corresponding to the position of the grating.

Projections extend for color and black and white films in that the slit system of the latter is easier.

An electron gun for firing down the necessary diffraction pattern for color recording has been developed at General Electric.

Good accelerating potential for the gun is 10 kv.

Beam Split

The electron beam in split into several beams whose amplitude and repetition are varied by potentiometer on media laser diodes. A deflection grating for each picture is thus formed by the split beam.

According to Dr. William E. Glens who is involved with the basic recording development, two such lenses, conjugated one with fixed and the other a variable spacing, but both with controlled intensity, are used to split the beam into four fixed and variable color pictures.

Aspects has an extensive program to explore methods of expanding lead with and shape directly and leading across time of exposure type, as well as to investigate electron beam, electron polarization, and photographic recording and accessories, according to Dr. Stephen A. Allen, an advisory engineer, writing in a special company report issued last fall.

Electron beam techniques appear to be promising for high-frequency recording. After noted, in two-wire devices, to permit high-pulse devices but also make direct voltage output almost impossible.



Goodyear Cures B-52 Redame Coverings

Reds of aircraft lights is used by Goodyear Aircraft Corp. to provide visibility, plus they captured plastic film for Boeing B-52 jet bomber tailfins. Glass shafts and even glass is used by the lights just to assembly with hexagonal structure.

be detected optically in a number of ways.

One of these units on the ability of a detector plate to absorb the place of ultraviolet or polarized light differently this would a detector plate.

Sanborning Surface

Electron beam scanning on magnetic material is also feasible, after said, by bombarding the surface after the material has been registered perpendicular to the plane of the film. The beam forms a small area of the film located in the same point thereby causing the initial magnetization. When the area needs adjustment away from center it is in the reverse direction of the original magnetization. The recording can be detected by transverse rotation or by electron beam microscope.

Form-electron recording processes to be in conflict very high frequency techniques because if such that to electron beam techniques and don't appear to have any potential upper limit, after contacted. Compared with magnetic materials, form-electron appears to permit high-pulse devices but also make direct voltage output almost impossible.

Radio-Telephone Link May Be Expanded

Washington—Expansion of public air ground radio-telephone service for airline passengers and general aviation to provide coverage along the "golden triangle" through new ground stations at Newark, Wichita and Pittsburgh will be authorized by the Federal Communications Commission during strong industry objections.

By such manner it should be possible for passengers almost entirely equipped with 40 lb. two-way radio-telephone sets and flying along the major air routes of the golden triangle to pick up a telephone handset aboard the airplane and place in service a call to or from almost any spot on the earth in less than one minute (AW Jan 12, 1956, p. 9).

The service, which has been in trial use in the Chicago and Denver areas for approximately two years, has proven extremely popular with business air traffic operators and with National Airlines passengers flying in several telephone-equipped aircraft.

The Canadian Bell Telephone Co. reportedly is consulting establishing

Republic High-Performance Titanium for the X-15



FIRST POWERED FLIGHT of the North American X-15 done on September 21, 1959, over Edwards AFB. Carrying a full load of fuel (some drop parachuted during 60 mph and sustained heating) the X-15 flew under power for 3.5 minutes at speeds in excess of Mach 5.

In a number of highly stressed components subject to extreme high and low temperature fluctuations, high-performance titanium in the X-15 Research Vehicle will help take man higher and faster than he has ever been before.

Republic Steel—a leading supplier of titanium, and the nation's largest producer of stainless steel alloys—is supplying North American Aviation with Type 110A titanium for internal structures on the X-15 project.

Let us help you utilize high-performance metals to increase strength, resist heat, or trim weight. Write Republic Steel, Dept. AW-8594, 1441 Republic Building, Cleveland 1, Ohio. Please indicate if you would like a titanium metallurgist to call.



SPRINKLING CHALLENGE Finishes and bending edges of the Canard B10's vertical fin and horizontal stabilizer where and being accomplished through electron heating of the metal. Use of Republic master? Stainless Steel increases strength and heat resistance, permits thinner, lighter gages. Types 301 and 302 are readily formed and shaped shapes by cold bending, drawing, and blanking operations.

REPUBLIC'S NEW HIGH STRENGTH POWDER, TYPE HS6440

Is ideal for forgings of highly stressed components. Provides minimum tensile strength of 45,000 psi at 4-4 density as poured. 1,000,000 psi after heat treatment. Dimensions of 300% shrinkage from size of 0.4 density. Available in quantities up to and including 10 tons or more. Can be used with existing existing equipment.

REPUBLIC VACUUM-HEAT TREATING has created in tensile strength levels of 200,000 to 300,000 psi are produced in stress treatment heat for metals such as the titanium. Vacuum arc furnace method segregates and removes porosity. Microscopic inclusions are reduced to number and size. Titanium ductility at high strength levels is also greatly improved.



REPUBLIC STEEL *Where Steels are*

Made to Meet the Challenge of Acceleration



How satellites can give us low cost emergency telephone service



Beyond their immediate military necessity, car-pooler rosters and missile programs promise many vital protective benefits to us all.

Well past the driving board stage are plans to use satellites in a low-cost emergency "dial-a-caller" system to relay telephone calls around the world.

Your call would be beamed to a satellite, then focused back to a receiving station on Earth. Cost is estimated at a fraction of what must be spent to install and maintain cables or radio relay towers.

While satellite telephone service is still in the future, that's the system that can put it into being—in dramatically improved form by Douglas, maker of the DC-4 jetliner. They have been successful in more than 90% of its tests. It is key because in the "dial-a-caller" design and located in the first test area reserved at 820MHz.

This is another product of the program and experience gained by Douglas in 18 years of missile development.

Launched by the Douglas-built Thor B66, satellites in this world relay telephone network operate in the world without costly cables or towers.

DOUGLAS



NUCLEAR AND SPACE SYSTEMS
MILITARY AIRCRAFT & JETLINERS
TRANSPORT AIRCRAFT & AIRCRAFT
ENGINE SUPPORT EQUIPMENT

ground radio-telephone service along portions of all of the major Canadian Arrows. General Telephone and Electric Corp. also is said to be considering an application to FCC for authorization to operate such a service along the West Coast of the U.S.

American Telephone & Telegraph Co., which operates the stations at Chicago and Detroit, says it keeps its land stations in Newark, Washington and Pittsburgh in operation by using

At least three companies are expected to offer the airborne radio-telephone system (RTTS) radio-telephone set required for airline and general aviation aircraft—AC Spark Plug Division of General Motors, Bendix Radio and Motorola. AC Spark Plug supplied most of the airborne equipment used in the Chicago-Detroit evaluation tests.

The FCC passed down AT&T's request for a new frequency allocation of two megahertz additional channels for public air-ground radio-telephone service. AT&T had asked for allocation of 151-153 mc and 419-441 mc.

Instead, the FCC proposed that the original service operate in the 411-415.0 mc and 415.4-416.0 mc bands, sharing them with the public mobile radio-telephone to which they already are allocated. FCC acknowledged the possibility of interference between the two services operating in the same band. The agency said, however, that it believes that specific frequency assignments for each type of service could be arranged by the common carrier to minimize interference.

The FCC indicated that the decision to deny the request for separate air-ground radio-telephone frequency allocation was based on restrictions as to how widely that service would be used. The agency pointed out that the reduced range of air-ground and the low-cost landline facilities available at airports indicated that the service would not find heavy use by airline passengers.

The AT&T request to the Federal Communications Commission was supported by petitioners led by Association of Radio, Inc. (ARI), in behalf of the airlines, AC Spark Plug and Motorola. The request also secured support from the National Business Aircraft Assn. and the National Assn. of State Airplane Owners.

CBS Electronics, Philco Sign Cross-Licensing Pact

CBS Electronics and Philco Corp. have entered into a cross-licensing agreement under which each firm allows the other to make, use and sell transistors and diodes of manufacture. CBS has ordered manufacture to copy its production line for manufacture of Philco process silicon transistors.



NOW! Automatically Control and Test Complex Electro-Mechanical Systems with complete reliability!

If you're having trouble testing complex electro-mechanical systems, it will pay you to investigate DIT-MCO's 250F26 Electro-Mechanical Systems Analyzer. It is specially designed to control and test integrated devices and their associated wiring by simulating controlling assemblies and monitoring their action. Each of the Analyzer's 250 test positions can perform up to 35 independent switching functions in response to control complex systems. Therefore, it almost eliminates in each test position the 250F26 will:

1. Activate all necessary reactive devices and provide termination-to-termination tests of each circuit for continuity and discontinuity.
2. Simulate conditions which allow it to operate and test each reactive device in the circuit under test.
3. Provide for visual measurement of reactive values and time delay constants where desired.
4. Provide switching capabilities which enable monitoring of signal patterns with external detecting devices.

These capabilities make it possible to achieve extremely high standards with complex relay chains and similar systems, thus eliminating hazardous errors which can lead to malfunctions under operating conditions. The 250F26 uses DIT-MCO's exclusive Metro Chart to put complete control information at a glance in front of the operator's eyes. The module is easy to operate, easy to interpret, easy to copy test. Write today for full details.

DIT MCO

ELECTRONICS DIVISION

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Secaucus, N.J. 07094

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SPECIFICATIONS:

1. Capacity: 250 test positions.
2. Test functions: 35 independent test functions.
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35. Test functions: 35 independent test functions.

All-new concept in Classified Area Protection



Guard posts once had armed guards
can't be everywhere at once



Honeywell's protective system cuts overhead,
blocks every square foot every moment!

New Honeywell system makes possible silent,
sound and movement surveillance of an entire
facility from one central location!



Greater protection for far less money

Here is a completely new concept in protective systems—a system that will not only pay for itself within a year by eliminating costly guard posts, but go right on adding to your profits for years.

For example, for every 24-hour guard post that you eliminate through this Honeywell system, you can save as to \$25,000. In larger areas, where more costs are eliminated, savings increase proportionately.

With this new Honeywell system, a central security point at his console can check instantly the security of any building or area—area include paths 20 miles or more distant. It provides your property against intrusion by all three means of detection: 1. Physical—the silent breaking in through doors or windows. 2. Audible—detection of sound or noise created by the intruder. 3. Motion—detection of movement of anyone that may have penetrated themselves within the plant.

Complete protection requires checks and balances

Trained with your security team, a Honeywell automatic alarm system can detect any form of illegal entry. Alerts can be received at stations. In many cases, a number of guard posts can be eliminated permanently. However, a security system would hardly be reliable without personnel to execute the program—and the Honeywell system is designed for complete response, thus providing a greater

degree of security without increasing your security force.

Key to the Honeywell system is the central control panel. All of the various sensing devices report here and all communications are centered here under one man's constant supervision. Moreover, no matter how disturbed, an alerted man in his location indicated here. Detection of fire is reported here and various critical alarm functions of the building can be monitored here—controlling complete surveillance of temperature, air pressure, lights, locks, doors.

Honeywell service assures maximum savings

Honeywell service adds to your savings—because it includes far more than ready access to one of our 113 branch offices. It includes field engineering help in planning your system, in addition to a service guarantee and a really dependable maintenance contract.

For a free survey of your facilities, call your nearest Honeywell office or write: Minneapolis-Honeywell, Department A-1-14, Minneapolis 1, Minnesota.

SUIT THE SYSTEM TO YOUR NEEDS



CENTRAL PANEL
location in control
at site



INTERCOMMER
device in location
in facility zone



ALARM BELL
1000 hours
of protection



AUTOMATIC FIRE
and smoke detector
alarm and location



VIDEO-SENTRY
remote system for
large facilities



MAGNETIC DOOR
alarm system
for doors

Honeywell

First in Control
SINCE 1887

75 YEARS



Flight checkout set (above) conducts a functional check of antenna communication and aerograph equipment in 2 min. Unit needs no physical connection with the aircraft. Depending on radio signal, it lights the operator's panel of the flight checkout unit. Operator's unit weighs 51 lb. and has pushouts wired point of the aircraft. Audible tone is modified version.



Remote Set Tests A3J Systems by Radio

By Wilcox S. Kent

Small, portable, battery-operated test set which can make a functional

check of an airplane's communication, aerograph and identification equipment without the need for direct connection to the aircraft or its engine equipment has been developed by the Technical Products Division of Pack and Bell Electronics Corp.

Although limited in scope for the A3J Vigilante under contract to the Columbia Division of North American Aviation, the test set can be used on virtually every military aircraft. Modified versions are now in use by conventional airlines.

Flight Checkout

Designed solely for flight checkout, the test set is not intended to replace maintenance within a particular piece of equipment but to provide a positive indication that thoroughly back-checked electronics gear is operating in its working environment.

Direct connection between test set and aircraft is unnecessary because the test set substitutes its test signals by radio frequency transmission. Signals generated by the test set are directional and short range (about 50 yd) to minimize interference with other radio aircraft or ground equipment.

Pack-Bell Senior Project Engineer

K. W. Gregg says the portable test set will accomplish the following particular checks:

- UHF communication radio headset test and receiver can be checked on ground channel, 242.0 mc., and on one other power channel. Good qualitative comparison of receiver sensitivity and transmitter signal strength on all channels.

- Voice communication headset check is made on a preselected frequency for both the speech leaving and listening—receiving portions of the equipment. Signals are transmitted to the Test set which causes a properly operating ADF specific to indicate that 90 deg. and 270 deg. DME portions of the equipment will be derived first in the one half position, then to the 180-degree position. An audible tone is transmitted by the test set, which provides a check of the station identification receiver tone to the pilot's headset.

- Search Identification Feature (SIF) and IFF equipment on L band can be checked for proper operation on any of multiple combinations in Modes 1, II, III and Emergency. Test set operator will receive an audible headset tone if the IFF SIF equipment is functioning normally.

- Electronic communication pass also can be checked functionally but test procedures involve considerable details.

For operation, the test set is placed 25 to

30 ft. in front of the aircraft and about 30 deg. off the starboard beam on the test set panel is oriented in the direction of the aircraft. Test set operator connects the UHF antenna and headset to which test signals and voice communication are delivered with an operator in the cockpit of the aircraft. After allowing 20 sec. for equipment warming, a pushbutton indicator of checks is conducted. Operator in the cockpit can verify or deny equipment operation with the test set engagement operator through UHF voice channel or by use of headset signals.

Directional Signals

Signals transmitted by the portable test set are directional to the extent that beam width is from 90 to 180 deg. and is divided 15 deg. up from the horizontal. Scanning the antenna in this manner produces interference with other aircraft and also causes operation on ground frequency without disturbing aircraft units. As a further precaution against cluttering up the defense frequency, the test set transmitter is turned 90 deg. off the 242.0 mc. frequency.

Duration of operation of the signal system between which power the test set is from 5 to 15 hr. without recharging. Standard operating procedure is for the test set to be plugged into a 115 v. a.c. source while not in use so that

ROCKET CASES!



Solar's giant rocket cases are advancing the state of the art

Advanced means components require specialized design, development and manufacturing skills.

Since 1957, Solar has been an industry leader in developing new materials and new fabricating techniques to increase strength, resist heat, reduce weight. Today Solar is using this background of knowledge and experience to produce giant rocket cases—nearly 30 feet in height—to existing standards of precision and strength.

Heat treated in the largest controlled atmosphere jet furnace in the world, the cases are an important example of Solar's active leadership in the field. Twenty-five heat treating furnaces—ranging from 18 inches to 9 feet by 30 feet—are performing difficult heating, annealing, normalizing, tempering, aging, hardening and other functions for America's leading missile and space programs.

These advanced facilities—plus a team of specialists experienced in the many phases of missile design and development—are important reasons why you should consider Solar first when faced with a difficult design or fabrication problem. For details write to Dept. G-178, Solar Aircraft Co., San Diego 15, California.



STANDARDIZATION: Challenging projects, un-
derstand opportunities with Solar. Write today!

the battery power supply is exchanged between the photoplates and cooled. Weight, complete with batteries and mounted in a valve-type carrying case, is 25 lb.

The test set will help eliminate serious errors and possibly diagnose communication and computer equipment failures. Grogg declares: "A fast check of both the AGO and DME portions of the Tustin test set is necessary to the pilot of a high-performance aircraft prior to takeoff on an IFR flight. Realistic knowledge that the UHF equipment is operating properly will decrease confusion in the cockpit failure to establish communication with another aircraft or facility has with each own gear or some other impending equipment."

Federal-Elco's shunted development of the test set in November, 1953 and now has three units in operation. Those, along with five more in order from North American (AW Inc. 11, p. 107) are scheduled to go ahead ship when the ATO story covers completion.

Presently there are 25 of another type of Federal-Elco test sets in operation with the addition, designed to provide a functional check of the aircraft's radar transmitter system. Federal-Elco has set up a production line for bench checkout sets.

A recent Federal Aviation Agency order requires that because the cockpit power is every flight.



► **As Phase finally accepted the first production diversity type unit, AN/FPN-35** located in Tusculum, Ala. at the year's end.

► **Defense electronics grow—like all military electronics continue, up approximately 15% in 1954 over the previous year, will grow another 15% in 1955, according to estimates by the Commerce Department Business and Defense Service Administration.** This, coupled with anticipated growth in components, industrial and consumer electronics, is expected to bring industry output to 210 million in 1955, BLSA estimates. State of New York produced 11% of the nation's output of military electronics equipment in 1954, with California in second place with 16%, according to an announcement by the Commerce Department Business and Defense Service Administration. Pennsylvania is third with nearly 9%. Microelectronics a fourth with nearly 1%, followed by Maryland with about 4%. Of the nation's total, breakdown according to states shows Massachusetts New York is first place with 19% and Los

Angela second with nearly 14%, followed by Philadelphia, Boston, Baltimore and Chicago.

► **Signal on the Dated Line—Major military events recently sponsored by various manufacturers include:**

► **Sperry Gyroscope Co.** will develop daylight indicator and transmittance power supply for AFN-39 side order \$140,000 research and development contract awarded by the Air National Command's Aeronautical Systems Center. Indicator will present long-persistent images 1,000 times brighter than those of previous indicators for the side.

► **Kennell Co., Inc.,** will supply an improved quantity of precision gyro and accelerometer to General Electric Co., Defense Dept. of Defense Electronics Division, in the Polaris program under a \$1,975,985 follow-on subcontract.

► **East Division of AGF Industries, Inc.,** will produce five electronic flight and logic simulator for the Naval Training Device Center, Port Washington, N. Y., under a \$2,752,880 contract. These simulators are slated for the F-4 and two for the F-105 variants of the Lockheed Neptune patrol plane.

► **General Electric Co.'s Heavy Military Electronics Department** will develop lightweight, air-sealable AN-95-41 for installation aboard destroyers under a \$3,606,000 contract from the Navy.

► **Ohio-Shepherd Industries, Inc.,** Columbus, N. J., will design and manufacture digital and analog reference signals for accuracy under a \$15,000 contract from Automatic Instruments Laboratory, Inc.

► **International Telephone & Telegraph Corp.'s Federal Division** will produce airborne Tustin set AN-51 and an associated daylight checkout equipment for F-106 jet interceptor under contracts exceeding \$1.5 million from Hughes Aircraft Co.

NEW AVIONIC PRODUCTS

Test Equipment

► **Signal generator, Model FA-5131** with local and remote controls, has 18 preset dialable frequencies in range from



100 to 516 mc. Generator is crystal controlled with $\pm 0.025\%$ stability over ambient range from -10 to 60°C. For 51 also has dual channel power output of 115 milliwatts. Telephone Industries Corp., Long Island City, N. Y.

► **Signal generator, Model SS-105**, provides tunable RF power for microwave pattern ranges and even range from 50 to 1,800 mc. calibrated to an accuracy of $\pm 2\%$. Suitable for remote tuning.



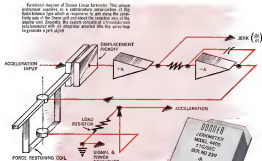
control and band switching at distances beyond a mile, source provides RF output of 50 milliwatts across 50 db. Power is 1,500 watts. Atlanta, Ga. Research Atlanta, Inc., 2345 Peachtree Road, N.E., Atlanta 9.

Components & Devices

► **Silicon transistors, Type CJ-112**, shunted junction PNP device, has guaranteed maximum collector output current of one ampere at $-12 \pm 15^\circ\text{C}$ and has base area minimum at 127°C. Base spread is from 16 to 25 and maximum voltage rating is -25 ± 5 Volts. Capital Corp., 249 Fifth Ave., Cambridge 02, Mass.

► **Filter capacitors, Type MF-100** (3rd and 4th round), available in capacities from 50 microfarads to 10 microfarads for 75 to 1,000 v. ranges without derating from -55 to $+100^\circ\text{C}$. Capacity tolerances of $\pm 10\%$ are standard, with tolerance down to 5% available. MF has voltage with 1 in. length, 6 in. width and 4 in. thickness and MR has length and 4 in. diameter. Capac. Inc., 61 Station St., New York 13, N. Y.

► **Switching diodes, IN202 IN203** series, ten switch 1 amp. pulses at 0.5 microsecond with peak power dissipation of 100 mw. Designed for operation up to 175°C. The IN203 series passes 100 milliwatt with 1 v. max. mean delay in forward direction and reverse a maximum in delay of 50 nanosecond at 175°C. Sperry Remondone Division, Sperry Rand Corp., So. Norwalk, Conn.



HOW TO MEASURE

$$\frac{da}{dt}$$

Now Donner precision Jerkometers measure linear and angular jerk to $\pm 0.5\%$ or better.

If peak measurement and control systems requires accurate measurement of jerk or the rate of change of acceleration, Donner Scientific's new line of precision angular and linear jerkometers can help.

These new instruments are the only truly sensitive devices of this type ever made. They are designed to meet the most demanding applications. Both angular and linear jerkometers provide an output voltage proportional to peak results as well as the total to

peak plus supplementary manual forms or other records. An accelerometer output amplifier is also available.

Typically a jerkometer consists of a piezoelectric transducer which provides an instantaneous output proportional to the rate of change of a . This signal can be used to produce engineering, design, or control data. Other applications include the laboratory control of acceleration in impact tests. The Donner Jerkometer provides a "memory" function. Here, the Donner Jerkometer provides a "memory" function. Here, the Donner Jerkometer provides a "memory" function. Here, the Donner Jerkometer provides a "memory" function.

KEY SPECIFICATIONS for Model 4405 Linear Jerkometer	RANGE Acceleration: ± 0.1 g full range to ± 50 g full range Jerk: ± 0.1 g/sec full range to ± 20 g/sec full range	HISTORICAL Data trend 1/5 POWER ± 15 mV at 10 mA and ± 15 mV at 10 mA 2" long, 1/2" wide, 1/2" high NOISE 25 mV
	OUTPUT FRI. SIGNALS Angular Jerk: ± 0.5 VDC Jerk: ± 0.5 VDC RESOLUTION 0.1% full scale or better LINEARITY 0.1% full scale or better	

MANY MORE INFORMATION! The new Donner Jerkometer is available in a variety of forms and provides accurate results in applications ranging from impact, seismic, and control system testing to vibration, acceleration, and velocity. Complete technical information can be obtained by calling your nearest Donner engineering office representative or writing Dept. 01-2.

DONNER SCIENTIFIC COMPANY
CONCORD, CALIFORNIA

FINANCIAL

Industry Profits Show Marked Decline

Widespread profit margins in the aviation industry dropped this past year to the lowest levels since the days of wholesale bankruptcies just after World War II.

This trend, under way since 1975, showed marked declines this year even while sales were showing modest increases. Figures compiled by the Securities and Exchange Commission show. The SEC expects these figures to be annual losses for the current and comparative quarters.

Based on sales, profit margins after taxes in the industry declined from 14% in the third quarter of 1978 to 1.1% in the third quarter of 1979. The decline was steady through last year, the corresponding third quarter.

Based on net worth, a controversial area between the industry and the regulators, third quarter profits dropped below the average for general manufacturing. Aerospace Industries Association figures show that in the first time aviation companies have dropped below general manufacturing since the early postwar period. The Board has not made an effort to control that industry profits are too high in some cases.

Comparative Trend

The comparative trend, shown in detail in the chart, was:

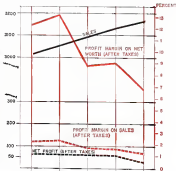
- All manufacturing—9.1% third quarter 1978, 9.4% third quarter 1979.
- Aerospace industry—12.4% third quarter 1978, 6.6% third quarter 1979.

The aviation group was lower than last but lost of the 12 categories and subcategories listed by the SEC. The lower was were the primary and steel, metals and mechanical industries, which probably were showing effects of the steel strike at that time. All figures are after taxes.

Comparing the two third quarters, sales for the industry were increasing 17%. Using the second quarter of 1979 for comparison, the increase in the third quarter was 1%.

The figures showed the following trends:

- All industry sales—\$1,816 million for the third quarter of 1978, \$3,136 million for the second quarter of 1979, and \$3,167 million for the third quarter 1979.
- All manufacturing sales—\$78,191 million third quarter 1978, \$83,305 million second quarter 1979, \$83,116 million third quarter 1979, per cent



DOWNWARD trend in aviation profit margins is shown in chart based on SEC figures.

change third quarter 1978 to third quarter 1979, 9% increase; second to third quarter, 1979, 0% decrease.

Aerospace profits after taxes—\$71 million third quarter 1978, \$54 million second quarter 1979, \$46 million third quarter 1979, per cent third quarter 1978 to third quarter 1979, 42% decrease; second to third quarter 1979, 14% decrease.

All manufacturing after taxes—\$1,320 million third quarter 1978, \$1,345 million second quarter 1979, \$1,345 million third quarter 1979, per cent third quarter 1978 to third quarter 1979, 15% increase; second to third quarter 1979, 18% decrease. The steel strike appears to have been a major factor in the second to third quarter 1979 declines here, especially in its effect on the automotive industry.

Reasons for Change

To some extent the increasing net worth of the aviation industry is companies retained earnings for use in the business helped to bring about the drop in profit margins on net worth. But primarily it has been the cut to profits

resulting from changing technologies and tighter competition and cost-cutting policies.

Profit Margins

The trend of profit margins on net worth for the relative industries since 1975 (SEC figures for last year).

	All Industry	Manufacturing
1975	21.4%	12.2%
1976	20.8%	12.6%
1977	17.1%	9.5%
1978	19.5%	9.5%

One AIA official said that the drop in profits will add to the problems companies will face in raising capital. The consistent downward outlook to be expected for public trading as profits fall forces the companies in the position of having to use their short-term funds for working capital and developing new facilities out of retained earnings. Whether the latter are growing enough proportionately to sales and in the best of future demand is a point of industry concern.

The AIA man, pointing to the effi-



*You can hear the future tick
in the last silent seconds
of a Rocketdyne countdown*

FOUR...THREE...TWO...ONE... a moment of silence. Then a gusty upsurge—and a bolt of man-made lightning flashes. Nearly every hour of every day, Rocketdyne technicians hear that dramatic moment as they test and tune the space engines of today.

The best-equipped test facilities for high thrust rocket engines in the nation are at their command. Rocketdyne's fully instrumented test structures are located in California's Santa Susana Mountains, Nevada, Missouri, and McGregor, Texas.

Rocketdyne engines have powered most of the military and scientific projects conducted by the Air Force, Army, and NASA. Now huge boosters of one and a half million pounds of thrust are emerging from the technical heavens of Atlas, Thor, Jupiter, and Redstone.

And even while today's countdowns go on, plans for tomorrow's assault on space are being made. At Rocketdyne, engineers and scientists are investigating such advanced forms of propulsion as ion engines, nuclear engines, plasma jets, and magnetohydrodynamic engines. Meanwhile other groups are at work on high-energy liquid and solid propellants, and dramatic new devices for both liquid and solid propulsion systems.

Rocketdyne, a 12-year pioneer in rocket technology, was first with power for America's long range ballistic missiles—first with power for Outer Space.



ROCKETMOTOR—a grain solid propellant rocket motor produced at Rocketdyne's McGregor, Texas, solid fuel facility—delivers 300,000 pounds of thrust, burns for as long as 1,200 mph.

FIRST WITH POWER FOR OUTER SPACE

ROCKETDYNE 12

A DIVISION OF NORTH AMERICAN AVIATION, INC.
Corporate Offices: Azusa, Azusa, Missouri, McGregor, Texas

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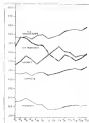
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Where there's business action, there's a businesspaper... where there's Aviation business, there's

**Aviation Week
and Space Technology**



See A-1000 of this/coverage prepared by the ASSOCIATES (A-1000) (A-1000)



PRICE TRENDERS for stocks on the New York Stock Exchange show general softening in the market for aviation securities, compared with other industries. The composite figure includes manufacturing, transportation, utilities, trade finance and services groups and mining. Prices are for the last quarter of 1979. The S&P index compares prices on the basis of 1926 = 100.

one of the complaints of General Accounting Office of industry privacy, of small business representatives that the industry is taking business away from small companies, and of the military that costs are too high, worsened up the situation by saying:

"Anyone who thinks the defense business is a great deal, easily maintains his or her position." With profits at their present level, the question of renegotiation might well become academic for the short-term period for which the act was intended last year. The industry still is concerned, however, over schedules that are being disrupted now or which might in the future be demanded for price cuts.

Collins Radio Profits Send Stock Soaring

Colin Kapke, Iowa—Sharp increase in first-quarter fiscal 1980 sales and profits for Collins Radio Co. sent the company's stock soaring less than two weeks after it was scheduled to trading on the New York Stock Exchange.

For the three-month period ending Oct. 31, Collins earned \$2.0 million on sales of \$42 million, equivalent to \$1.31 per share of the common stock outstanding.

By comparison, the company earned \$1.95 per share for all of fiscal 1979, ending July 31, on profits of \$17 million, highest in its history, with sales of \$17.5 million.

Collins, a Wall Street favorite at several years ago until its profits tumbled in 1977 and 1978, appears to have again regained the investor's favor. Company stock which had sold for less than \$10 across the country at one time during 1978, and which traded for around \$30 in early October, opened

at \$35 per share on Dec. 5 on the New York Exchange. Following the customary pattern, it dropped to about \$45 shortly afterward only to rebound to around \$70 as first-quarter earnings were announced.

At the \$70 price, Collins was selling for around 14 times its earnings, based on first-quarter profits.

This is a modest figure, compared with some of the electronic favorites, such as Lattice and Texas Instruments which currently sell for about 40 times earnings.

Collins backlog, including contracts under negotiation, is about \$200 million, roughly the same figure as the July 31 backlog.

Company's growing sales reflect the increasing military need for communications systems for command and control of strategic, or defense and tactical operations, a trend which appears likely to continue. However, the company also has a sizable market in industrial communications equipment and services equipment for radio and land line circuits.

Engineered profit picture reportedly results in part from fact that the company is able to use increasing amounts of off the shelf hardware and existing design efforts for its production contracts. Its contribution, and its effect in 1979 also appears to be a contributing factor.

Each division is semi-autonomous and operates financially as if were a separate company.

This has reduced costs and improved management control, the company reports.



Rocket Sled Propels One Ton at 2,500 Fps.

Rocket sled developed the high-speed test concept and complete mobile propulsion system under modified launch system is tested at Edwards AFB, N. M. North American Aviation's Rocketdyne Division is prime contractor for the sled, North American Los Angeles Division participated in design and manufacture of the vehicle. Sled is 45 ft long and 40 in high, and is powered by a Ramjet engine using liquid oxygen and alcohol and nitrogen-oxygenated fuel system. Burner capacity is 5000 gpm. Thrust rating is variable—200,000 to 100,000 lb—fuel is achieved by preheating. Variable burning duration of 21 to 30 sec. also is achieved by preheating. Acceleration is up to 2g. The vehicle will propel one ton at payload to 3,500 ft (1,700 mph) on the seven-mile track.

For drastic weight and space reduction!

For safest handling of cryogenic, exotic,
radioactive and conventional fluids!

Products of
COMPONENTS DEPT., RMD

For unsurpassed reliability!

VENTURI Shut-off VALVES

... for modern aircraft and
missile propulsion systems,
ground handling and nuclear applications

- No dynamic loads
- Zero leakage
- Low energy requirement
- Full safe
- Low pressure drop
- Low pressure operated
- High reliability
- No external actuation
- Minimum of moving parts
- Suitable for hazardous fluids, exotic fluids

The Venturi Shut-off Valve shown here are typical of the advanced valve design and development capability of Reaction Motors—pressure is mutual engine, missile components and support equipment. Capabilities include all forms of design, development and production testing of valves, gas pressure regulators and flowmeters. Complete in-plant environmental test facilities. Wide experience in designing for cryogenic, exotic, toxic and radioactive fluids. Carefully in production on large GTP-10000, quick disconnect valves, 10000 regulators and X-15 components and valves for classified projects. Reaction Motors can deliver valves designed to your special requirements within 6 to 12 weeks!



Cryogenic Shut-off Valve

Oxidizing Vapors Shut-off Valve

COMPONENTS DEPARTMENT
REACTION MOTORS DIVISION

Thiokol CHEMICAL CORPORATION

Ford Road, Greenville, New Jersey

U.S. Allocates \$57,076,702 For 1960 Airport Construction

Washington-Airport construction projects for fiscal 1960 will cost \$57,076,702 in federal funds, a new list will be matched on a 50-50 basis by local project sponsors. Allocations are based on \$6.1 billion made available by Congress under a two-year extension of the Federal Airport Act.

Of the money, approximately 10% is allocated for runway construction, 14.1% for terminals and aprons and 16.7% for land acquisition. Remainder is allocated for projects ranging from lighting to road construction.

Texas and California—each 17 airports—the largest number of projects, followed by Illinois with 15 and Michigan and Wisconsin with 11 each. Following is a list of the 788 projects allocated.

FEDERAL-AID AIRPORT PROGRAM

(All in federal funds)

ALABAMA

Birmingham 100,000 sq ft terminal 100,000

Mobile 100,000 sq ft terminal 100,000

Montgomery 100,000 sq ft terminal 100,000

Prichard 100,000 sq ft terminal 100,000

Tomball 100,000 sq ft terminal 100,000

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Wetumpka 100,000 sq ft terminal 100,000

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BLOCKS
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ELECTROHYDRAULIC SERVO VALVE

Kearfott's unique approach to electrohydraulic feedback applications design has resulted in a high-performance miniature servo valve with fast time moving parts. Easily suited to aircraft, spacecraft and industrial applications, these mini-valves are 2-stage, 4-way center where service high frequency response and proved reliability even with highly viscous media fluids and under conditions of extreme temperatures.

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Pressure . . . 250 psi
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Flow range . . . 0.1 to 100 gpm
Temperature . . . -50 to 200°F
Torque . . . 100 in-lb
Flow range . . . 0.1 to 100 gpm
Temperature . . . -50 to 200°F
Torque . . . 100 in-lb
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Temperature . . . -50 to 200°F
Torque . . . 100 in-lb

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multiple
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zero-lock
contacts

Adapt available
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higher and more
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made to order.
Prices available
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crimp-type

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Modular units by Burndy provide versatile, rapid and reliable answers to the problem of connecting a multiplicity of wires in relatively limited spaces. Crimped contacts—installed with any of several hand, pneumatic, semi-automatic or automatic tools—can be removed, reinserted or replaced, providing the most complete flexibility in the connector field. Computers, ground-based radar, missile ground controls, and instrumentation are typical applications for Burndy modular connectors.

quick-disconnect
or permanently
connected

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with snap-in
spring-loaded
contacts

True versatility in a terminal block. 35 models in 2 or 4 foot per foot. Made of a continuous fusible plastic. Quick disconnect contacts for permanent connection.



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solid-shank

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contacts

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family design
button is the
modular con-
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vide custom-
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**AIRBORNE
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This far-reaching activity is involved in engineering development, design, and manufacture of all types of airborne—and aerospace—electronic systems and equipment. Current projects approximate conception of several complete weapon system support units (including missile and outer-space gear), communications, electronic warfare, and aerospace warfare systems.

As an RCA systems engineer, you will not only be responsible for creating some of today's most vital strategic defense weaponry... but will be able to advance rapidly, as an individual, on a highly liberal merit basis. This is an extremely unusual growth situation. To keep you free for only creative activities, a vast array of well-staffed, well-equipped facilities—both research and manufacturing—are on hand to support you at all times.

A select number of openings now exist for systems engineers and operations research personnel with broad experience in military systems. If you qualify... and are ready to take a giant step forward in your professional career... please send a resume to:

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Mach 6.7 Air Transport

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Bold plans revealed in Lockheed's program of total flight technology

Air/Space travel, whether the vehicle is manned or unmanned, poses vast problems. To expand the total technology of flight, Lockheed's California Division proposes bold new concepts for both military and commercial vehicles. In line with this, the Company has assumed major responsibility for Research and Development in future space vehicles. This responsibility extends from development of advanced components to major complex systems.

Advanced projects to spring from this broad base of Air/Space travel include: Lunsdale-Helicopters designed for shuttle service between large cities and suburbs, or to transit terminals; Mach 6-7 Air Transports able to take off and land vertically; Space Transports capable of transporting, to an orbit of more than 1000 miles, a pilot and 1000 pounds of payload, or three passengers equipped to work in space; advanced

Infrared Systems studies as an advanced detection method and Solar Radiation studies.

This markedly expanded program into the total concept of flight creates urgent need for personnel with high-level skills. The necessary talents often inherent to hyper-space extend, from atmospheric to outer space vehicles.

High-caliber scientists and engineers are invited to take advantage of the need, to investigate the many career opportunities Lockheed offers.

Immediate openings are available in: Aero-thermodynamics; propulsion; armament; electronics—research, systems, packaging; servomechanisms—flight controls; sound and vibration; physics—infrared, acoustics, electrophysics; antennas and telemetry.

Write today to: Mr. R. W. Des Lauriers, Manager Professional Placement Staff, Dept. 11013, 2400 North Hollywood Way, Burbank, California.



JOB 5 Sport and business flying plane has good pilot visibility; plane can be used for aerobatics and towing gliders.

JOB 5 Sport Plane Enters Final Testing

By Edith Walker

Spaul-Dee, Austin-Turner prototype of the JOB 5 two-to-three seat, low wing, all-wood sport plane, built by Paul Oberholzer-Helicopter Co. here is now undergoing final type tests.

This is the first powered aircraft to be produced by the company. Oberholzer hopes that low price and an uncomplicated structure coupled with easy and inexpensive maintenance will help to generate considerable interest in the plane, particularly among area clubs and schools as well as private pilots.

The firm, founded in 1945, is well established as a glider designer and manufacturer. It has built approximately 4,000 gliders so far of which the Stowacki, Mfg 73, Lo 100 and Lo 191, for example, have won extensive national recognition and championships in recent years.

During the last 10 years the company has also maintained and repaired aircraft for private owners and various air clubs.

Designed by Austrian engineer Richard Oberholzer for towing sport and business flying, the JOB 5 can fly



FUTURE modifications include a change to biplane landing gear and three-place seating.

ANNOUNCING



27th ANNUAL INVENTORY OF AEROSPACE POWER

PUBLISHING DATE: MARCH 7, 1980

SPACE RESERVATIONS CLOSE
February 15, 1980

A REVIEW AND PREVIEW OF WORLD-WIDE AVIATION MISSILE AND SPACE DEVELOPMENTS

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Aircraft . . . Supersonic Transport . . . Aerial Targets . . .
... are some of the dramatic breakthroughs in aviation,
missile and space progress which have captured the
imagination and thinking of scientific, military, govern-
ment and industry planners.

In the world's most dynamic industry, interpreting these
events is vital to our economic welfare. Each event must
be studied individually and in terms of industry-wide
technological direction. The galloping pace of progress
makes it impossible for even well informed engineering-
management men to do this job . . . it takes specialists.

RECOGNIZED AUTHORITY

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decision makers . . . have turned to the industry's top
technical reporting team and the Inventory of Aerospace
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Will tomorrow be a challenge ...or a bore?



If you feel that your present job is not fully tapping your potential, here are 4 new career opportunities for Electronics Engineers that have every bit of the challenge you may be looking for . . .

1. Radar Systems Reliability Engineer: This position calls for a seasoned engineer capable of integrating and directing systems reliability assessment activities necessary to acquire customer acceptance of the detection system. Usual combination of technical ability, relations and communications (written and spoken) is required.

2. Radar Equipment Systems Specialist: This position calls for a creative engineer capable of conceiving and directing the design of long-range radar systems. Desirable experience includes around ten years in

required. Desirable experience includes approximately ten years in design and field installation of transmitters or electronic systems with ability in both electronics and mechanical fields. Ability to motivate technicians for optimum performance is necessary. Salary structure is equal to the challenge.

at least one of the following radar systems design, systems systems, R.F. components, radar receiver systems or radar data processing systems. Salary structure is equal to the challenge.

3. Advanced Systems Engineer: This position calls for a creative engineer capable of defining future designs and space detection problems as well as the ability to conceive and establish the feasibility of optimum systems solutions to these problems—making use of the most advanced techniques and engineering. He must recognize the need for and coordinate the development of new techniques and the exploration of

new phenomena in the area of detection systems. Background desired: Bachelor degree plus a combination of advanced training and several years experience in both the theoretical and practical aspects of detection systems engineering. A desire to work in the conceptual phase of system design with the analytical ability required to evaluate and demonstrate the effectiveness of proposed systems.

4. Advanced Radar Systems Analysis and Development Engineer: Engineers are needed who are able to visualize and define future defense and space problems—creative advanced radar systems to solve them. An advanced degree and/or strong background in system analysis and design is essential. Assignments open

include analysis and define requirements for advanced detection systems and determine broader parameters for such systems, establish their feasibility, analyze long range missile detection systems and specify optimum configuration on the basis of ability, performance, cost and delivery. 100

All of these openings are an General Electric missile and satellite detection projects and will be filled with engineers having the capability and desire to make creative contributions.

Write in confidence to E. M. George,
Supervisor—Personnel Administration
Missile Detection Systems Section
HEAVY MILITARY ELECTRONICS DEPARTMENT
GENERAL ELECTRIC
SYRACUSE, NEW YORK



WIDE SPACES leading gear gives the JOB 5 sport plane good rough field characteristics

be used for towing gliders and for basic aerobics.

Powerplant is a single Continental C-50 112F engine developing 95 hp at 2,625 and 90 hp at 2,475 rpm.

Design Details

The wings are constructed as three sections. The two outer center sections of 54 in. span, under the leading gear, have controls and safety-belt attachment. The single inner outer panel has a structure outer spar which is mounted by the wing with the gear wing disposed to form the fuselage nose. The rest of the wing section is fabric-covered. The elevator has a fabric-covered skin.

Monocoque fuselage now is fitted with a large fixed plastic glass canopy, offering a good all-around view. It can be pushed back or completely removed as desired.

Torsion spar of the cabin is made of plywood in the ribs and trailing edge. Fuselage is fabric-covered.

The structure has a single spar with a sheet auxiliary nose spar and is intended to be finished in four places. It is covered with plywood and fitted with a trim rib which can be controlled from the cockpit.

Two-wheel landing gear has hydraulic brakes. Rubber spring tail wheel is coupled to the cabin and in the event of large side loads automatically from the cabin, and also allows the aircraft to be turned around and moved into position on the ground.

The landing gear has increased springs which are bolted to a beam made of rail and tubing in the center section of the wing.

Overhauler is currently completing the first production run of the JOB 5 and several models are expected to be

HUMAN FACTORS SPECIALISTS

Based on the premise that the present systems of future space programs must be designed in the same manner as the present CONVAIR AERONAUTICS, has worldwide experience in its Human Factors Department on the AFSS and future space systems. These men must be educated and trained in Psychology and Engineering to equipment related in the fields of military and space flight, and have a knowledge of the latest air characteristics and technical training.

If qualified, write to: F. W. Wells,
Engineering Personnel Administrator
Box 110-10

CONVAIR AERONAUTICS

CONVAIR is a part of
**GENERAL
DYNAMICS**
Box 110-10, Torrance, California



JOB 5 Performance

(With payload of 45 lbs. payload and 75 lbs. diameter)

Maximum speed	312 mph
Cruising speed	99 mph
Rate of climb (with gross weight of 1,320 lb.)	797 fpm
Service ceiling	10,000 ft.
Range	996 mi.
Duration of flight	4.1 hr.
Takedoff distance over an obstacle of 4920 ft.	1,118 ft.
Crossed tail	487 ft.
Maximum speed	49.5 mph
Fuel consumption at cruising speed	4.75 gph
Fuel capacity	19.1 gal.

	Three-wheel version	Two-wheel version
Gross weight	1,597 lb.	1,318 lb.
Empty weight	941 lb.	941 lb.
Useful load	552 lb.	376 lb.

* Including full instrumentation.

Let's look at it from your point of view, Mr. Engineer



You're in demand, there's no doubt about that, and rightly so. Went ed, after went ed, double premium and reward for your talents. Many firms offer challenges, and it's hardly one that doesn't have opportunities.

So we begin by admitting that there are the facts. And we frankly asked ourselves what do we, Psychomatic Systems Division, have to offer a person like you.

We believe we have something new to offer. It's a management policy. It's expressed in the phrase, "Bayhous invests in a change for talent." We find this is a place someone who you would want to look into. It's not a slogan, it's a fact. A fact that Bayhous Medical Systems Diversity management has made a policy that is adopted to.

If it's opportunities you seek, they're certainly here. Raytheon's Missile Systems Division is the largest division of the Raytheon Company — and it is one of the fastest growing divisions too. We think this fact is proof of our policy.

If it's a challenge you meet, Raytheon is the world's only purely defense company with prime responsibility for two major missile systems—the challenge here is great.

Perhaps it is better living conditions that would be a great deciding factor. New England offers beaches, mountains, and excellent suburban living, and we are in the heart of New England.

So we have the many things you're probably looking for in a position — but most important we have a policy that allows for you — we create a climate for talent. Maybe that's the reason we have grown so quickly. Perhaps that, and the other reasons we've stated, are reasons enough for you to investigate us more thoroughly. Do you meet these requirements?

Call collect 617-526-0804 for further information and an interview appointment. Ask for Mr. Jerry Morris. If you prefer, address your postcard or letter to Mr. Jerry Morris, Professional Employment, Raytheon Company, Bedford, Massachusetts.

Circuit Design Engineers... with experience in design of high-speed switching circuits, pulse techniques, and computer logic in one or more of the following areas: surveillance, radars, control circuits, DDM, FM, PCM, EDD, and power circuitry.

Gate Reading Engineers... with experience in high-speed, analog-to-digital conversion techniques, logic design, converter and buffer design. Should have thorough knowledge of tape recorder techniques and digital, servo, and digital-computer design.



TRIM-VIEW of J08-5 prototype shows large coolant passage area, wide gap.

ready for demonstration purposes by spring 1960. First delivery dates and price of the aircraft will also not be available in the spring, but a spokesman for the company says cost will probably be around \$7,700 (\$1,000 Swiss francs). Tires and tank indicator, altimeter, tachometer, rate of climb indicator, compass, impact indicator, oil pressure gage, oil temperature gage, low fuel pressure gage and fuel quantity indicator, for example, and first aid kit are included in the standard equipment.

Modifications Proposed

Next step in the KIR series will include the following modifications of the test instrument:

- Interlocking seating supports so that passengers including the pilot will be in front and one passenger behind the adjustable front seats.
- Fuselage will be of fabric-reinforced steel tube construction with built-in heating gliders.
- Later models will have nose wheel landing gear.
- One-piece wing equipped with flaps.
- Powerplant of future models will be a Lycoming 9-290-42B engine rated at 115 hp.

The aircraft will comply with normal category of Civil Air Regulations for a three-passenger aircraft (gross weight

1,545 lb with an average additional load of 314 lb) and with the U.S. standards, reaching the necessary 10

which the plant may be used, that is - be established commercial crops.

part of passengers, private flying, business flying and demonstrative flights."

The highest reason (gross weight

1000

creativity

Out here in Kansas there's still space to breathe. You can still drive your car to work in minutes, think in a free creative environment on dynamic projects undimmed by soot or smog.

to the best of Mid-American living in Wichita, where your family will enjoy superior housing, excellent schools and churches, ample cultural and recreational facilities, and the bracing, healthful climate of four true seasons.

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RYAN ELECTRONICS

DIVISION OF RYAN AERONAUTICAL COMPANY TORRANCE, CALIFORNIA SAN DIEGO, CALIFORNIA

JOB 5 Dimensions

Span	30.2 ft
Length	26.8 ft
Height	5.3 ft
Wing area	129 sq. ft.
Wing loading	
(thrust-to-weight)	11.4 psf
(thrust-to-weight)	10.1 psf
Power loading	
(thrust-to-weight)	16.6 lb.-hp
(thrust-to-weight)	14.7 lb.-hp
Aspect ratio	10.4

1,540 lbs.) may be used for training and instruction purposes, emergency and rescue flights, first and last flights, and basic simulation, according to utilization group 4 of the German aircraft construction regulations.

Flight data obtained so far agrees with the anticipated performance within a maximum variation of plus or minus 8% according to designers.

PRIVATE LINES

Independent safety research organization has been formed by A. Howard Hubbard, who has resigned after five years as director of the Aviation Safety Council of Cornell University, sponsored by the Flight Safety Foundation. The new organization will have temporary headquarters at Gillette, Ala., and is aimed at accident and injury prevention in the aviation, space and automotive fields.

Allied International Corp., of New York City, has been appointed distributor of the Hiller UH helicopter to the United Arab Emirates, Lebanon, Kuwait and Iraq, according to A. L. (Phil) Patterson, Allied vice president. Helicopter is the economical version of the Army's H-23D Bristle.

United Steel Companies, Ltd., of Sheffield, England, is planning construction of an airport near its headquarters for use by the company's executives and associates. Airport will be designed for light aircraft only. Local council approval is for five years.

Polish Lightplane Details

Warsaw-Poland has released basic specifications on its PZL-102 Koz (Black Swift) and Buz (Dormant) light planes.

The 41 hp, four-cylinder Koz, designed primarily for sports and "tourist" use, is 21.5 ft. long and has a 21.9 ft. wing span. Empty weight is 1,200 lb., top speed is 182 mph and cruise is 455 mi.

The Buz trainer is 21.4 ft. long and has a 14.5 ft. wingspan. Empty weight is 1,440 lb., top speed is 175 mph and cruise 465 mi.

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Technical Employment
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Cherry Hill,
Camden 8, New Jersey



RCA SERVICE COMPANY
A Division of Radio Corporation of America

WHO'S WHERE

(Continued from page 17)

Changes

Seacore Corp., Richard, Calif., has announced the following appointments: C. J. Gilbert, director of manufacturing; B. T. Davidson, director of administration; Joe Scholard, director of contract administration.

D. Edwin G. A. Peterson, manager of development, Research and Development Department, Division of Radio, General Electric, York, Pa.

Jack M. Chese, assistant to the president, Shor Lok Corp., Seattle, Calif.

Fred H. Hatcher, purchasing agent, The Fisher-Bowyer Co., New Britain, Conn.; Dr. Samuel Levine, director of research and research, Lockheed, Burbank, Division; Fairchild Camera and Instrument Corp., Secaucus, N. J.; Alvin Robert Brown, Jr., marketing manager for the division.

Dr. S. Don Warden, manager of Food and Planning, Agricultural Division of Food Value Co., Newport Beach, Calif.; Mrs. Dr. R. E. Anderson, head of the Operations Research Section in the Army Technical Operations Control (ARTOC) project, Los Angeles; Computer Operations Research, W. Wells, director of engineering, Aircraft Research, Inc., Cockeville, Mo.

Dr. Gertrude E. Miller has joined the general staff of National Engineering Service Co., Pasadena, Calif.

Vernon Taylor is now a research scientist in the staff of Flight Safety Foundation, Inc., New York, N. Y.

James C. Jenson, manager, Aerospace Division of Aero-General Corp., Downers Grove, Ill.

H. Wilson Thomas, product development manager, Aerospace Division of Chance Vought Aircraft, Inc., Dallas, Tex.; Mrs. T. W. Shanks, director of quality control and service, Aerospace Division of Chance Vought.

Bernard Koshitzky, industrial marketing manager, Electric-Mechanical Division of Low, Inc., Coral Gables, Mich.

Frank M. Wilson, manager, Fluid Dynamics Division, Lockheed Aircraft Corp., Marietta, Ga.; Division.

Robert L. Jones, corporate marketing director, Loeb Corp., Cranston, Calif.; Dr. E. S. Anderson, manager, and Neil A. Marshall, chief engineer, Special Food 101 Division of Loeb Corp.

Conrad Koenig, product development manager, General Electric Division of General Dynamics Corp., San Diego, Calif.

Red F. Moore, engineering consultant, Aerospace Electronics Department of State Engineering, Inc., Pasadena, N. J.

Dr. Joseph Hall, director of the Research Laboratory, Union Industries Electronics Tube Division, San Carlos, Calif.; Alvin Robert D. Knapton, general manager of the San Jose, Calif. plant of the Electron Tube Division.

Donald G. O'Connor, assistant to the president, engineering and research, General Dynamics-Liquidation Corp., New York, N. Y.



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AVIATION WEEK, January 18, 1962

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AVIATION WEEK, January 22, 1960

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SMI's LOX Tanking Computer, which has been in production for the past year, accurately measures, controls and indicates the level of liquid oxygen in missile tanks. Loading is accomplished rapidly and accurately due to a unique two-mode control system. The first mode permits extremely high pumping rates until about 98% capacity is reached. The second mode then takes over and controls a precise proportioning valve which adds the necessary LOX to fill the tank within 0.1% accuracy. The second mode also provides continuous topping, thus compensating for LOX evaporation losses during standby.

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